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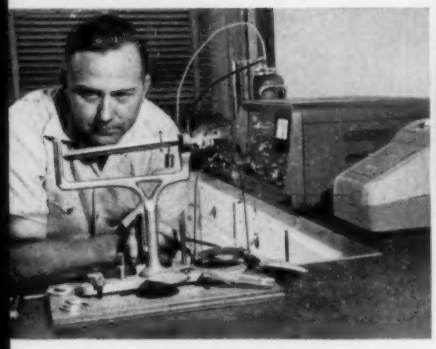

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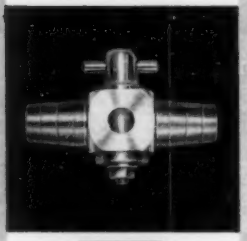

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Credit in Education?

In a recent survey conducted under the auspices of the Science Teaching Improvement Program, more than 200 colleges and universities in all parts of the country indicated that they are now offering special courses in subject matter in science and mathematics for teachers for which graduate credit is given. In a number of instances these courses will be offered for the first time during the summer session of 1956. The survey does not show whether credit for the courses is to be granted in the subject matter, such as mathematics or physics, or in education. It is assumed that, where graduate credit is allowed, the credit can be counted in partial fulfillment of requirements for the master's degree in education, in some plan for a combined master's degree in education and a science subject, or for a master of science teaching degree.

The need for such courses is generally recognized. Many of the present secondary-school science and mathematics teachers were prepared to teach some other subject. A considerable number of others were undergraduates more than 10 years ago. Not only scientists but the secondary-school teachers themselves are aware of the need for content courses that are planned especially for teachers. One of the goals of the Science Teaching Improvement Program is to foster the offering of such courses. The summer institute program of the National Science Foundation, now extended at Wisconsin and Oklahoma A and M to include year-long institutes, has made a major contribution in making available content courses for science and mathematics teachers. This is one of the most significant developments in teacher education in the past 20 years.

When the desirability of special course offerings for teachers is discussed with scientists, the question of graduate credit is always raised. Some institutions, as noted above, do offer graduate credit. Others offer these courses for undergraduate credit. Since many salary schedules are based on number of hours of graduate credit earned or upon the master's degree, the courses that are offered for graduate credit lead to more satisfactory enrollments. Some propose that there should be an organized effort to bring about change in salary schedules, so that credit for content courses at the undergraduate level would meet salary schedule requirements. Because of the complexity of the American public school system and the decentralized control in a multitude of small districts, this suggestion does not appear very practical. The question of whether this would be desirable could also be raised. One of the great present needs is to add to the prestige and status of the teacher and to his feeling of competence in the subject he teaches.

Another problem related to these course offerings is whether the courses should be listed as mathematics, physics, or other science or as education. Practice in the various universities seems about equally divided on this. The reason for the reluctance of the science departments to offer these courses as regular departmental courses is fairly obvious. Since the courses are planned for teachers, it seems to some only appropriate that the courses be listed as education courses. On the other hand, scientists are unhappy, with justification, when they see included in a teacher's credentials many more hours of credit in education than in the science subject taught. Furthermore, credit in science will add to the confidence of the teacher, to his interest in the subject, and to his pride in being a "subject" teacher rather than a generalist. Teachers obtain genuine satisfaction from credit and grade in mathematics or in a science. In some schools such credit would be of considerable assistance to the teacher in securing promotion to a position as head of the department or as supervisor in science.

This is a period of experimentation and change in teacher education. Level of credit and course label become important questions in the total picture of improving secondary-school science teaching.—JOHN R. MAYOR, *Director, AAAS Science Teaching Improvement Program*

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Can We Halt the Race for Atomic Arms?

Clinton P. Anderson

My purpose is to ask if there is a role that men of science may play in proposing an affirmative answer to the question: Can we halt the race for atomic arms?

Day by day in the Congress of the United States we are alerted to this question. It colors the debate on the size of our military establishment. It increases as our agricultural storehouses fill and overflow. It influences the volume of our foreign aid. It throws into sharp controversy the relative value of guided missiles and jet aircraft. It builds a nuclear navy and equips an atomic army. We know all about Nike batteries; we watch ground-to-air, air-to-ground, and air-to-air encounters. But we find no peace.

And yet, through all our thinking runs the belief that the true significance and greater ultimate effect of atomic energy for the human race will come not from its destructive capabilities but from its contributions to the betterment of man's lot upon this earth. The weapons of mass destruction are impressive but so would be the fruits of peace. The difficulty has been that the power to destroy comes before and grows faster than the power to build.

The conviction is growing that disarmament, in the sense in which it was proposed and may have been possible from 1945 to 1948, has now become impossible. There was once a day when a rigid system of inspection could have prevented the growth of dangerous stockpiles of fissionable materials for military use, but in the last decade the sizes of stockpiles held by the principal atomic powers have presumably grown so large that substantial amounts could be secreted before any inspection system begins and would be adequate for a devastating attack if one of the powers so chose. But wholly apart from this question of secreting materials before initiating inspection, it might be recognized that even if this did not occur and a rigid inspection system and control of materials were imposed, then still, in the event of war, the facilities that have grown up for peacetime uses of atomic energy are of such productive capacity that it would not be long after the outbreak of war until adequate materials would have been produced for full-scale atomic devastation.

Moreover, we should not restrict ourselves merely to consideration of hazards implicit in wars of annihilation with atomic weapons. In technology applied to military ends, novelty is ever a prime goal. Thus there is the probability that a war between major powers would lead to types of destruction of a nature and scope not yet conceived, much less demonstrated.

Modern war makes certain for all participants their near annihilation and makes military conquest utterly illogical and absurd. The great powers of today thus find themselves in a sort of uneasy stalemate. Each is concerned with maintaining heavy retaliatory forces to insure that the other dare not risk the gamble of military conquest but, in turn, dares not risk it on his own except as a result of monstrous blunder.

Although much time will pass before we work our way out of our current military stalemate, certainly it is a hazardous stalemate that no one likes, and it may have merit only if we use the time it provides to take advantage of the evident value of peaceful collaboration on projects of common concern. Says the editor of the *Bulletin of Atomic Scientists*, "Atomic deadlock can have positive value only if man uses the breathing spell it provides to develop a permanent foundation for peace without terror."

On the one hand, we may strive to use this period for creating mutual respect for, and consent to use, the machinery of an expanded and strengthened United Nations to mediate international disputes and to diminish tensions that arise from international rivalries. On the other hand, we may move toward direct collaboration on technical projects, which the high level of modern technology makes unusually productive and beneficial to all concerned.

Obstacles to Joint Developments

Here I would like to mention several projects that seem especially appropriate for joint developments in world laboratories. But before doing so, let us look at some road blocks in this path.

Restrictions on free travel and free exchange of information have become increasingly irksome in recent years. These restrictions have fallen heavily on many scientists, on people in the arts, on businessmen, sometimes on religious leaders or other people whose interests and pursuits are not confined by national borders. The justification of these restrictions is the implicit argument that somehow they increase the national security and well-being of the nation that applies them. But today with the rapid approach of the time when any country that launches atomic warfare can create untold damage at will, we should examine whether we can remove many of our restrictions on free travel and exchange of information. We should encourage, by whatever means we can, the spirit of international cooperation and openness that will minimize the chances of a misunderstanding —an accidental spark that would lead to disaster.

One step we can take in this direction is to remove our present restrictions on transmission of nonsecret scientific information among nations. The United States has helped to foster such restrictions, but

Mr. Anderson is the junior U.S. Senator from New Mexico and chairman of the Joint Committee on Atomic Energy. This article is based on an address that he gave before the sixth annual Conference on High-Energy Nuclear Physics on 6 Apr. in Rochester, N.Y.

their contribution to our security is open to question. We know that such measures foster fear and suspicion rather than cooperation and understanding. They decrease the rate of gain of knowledge, which is at the maximum only when free communication exists. Physical truths cannot be protected by such policies. They are everywhere the same—equally measurable in any laboratory.

Exchange of Teachers and Students

We can break down barriers in communications still farther by encouraging an expansion in our present system of exchange of teachers and students among nations. Most of our American universities do not have visiting professors from other lands on their faculties but would be happy to have them. Many of our own scientists go abroad to study and teach in foreign institutions. They come back with new ideas, a fresher outlook on their own problems which cannot help but be of benefit to science as a whole. An increase in opportunities for exchange of faculty and students between our great institutions of learning would be an important integrating factor in our pursuit of knowledge. We have plenty of disintegrating influences; we need men and women who are concerned with mutual problems and prepared to dedicate themselves to their solution.

The importance of the international meetings cannot be overemphasized. Information exchanged among participants will hasten the day when science will understand the secrets of the nucleus and of fundamental particles and will move man another step forward in his understanding of the universe about him.

World Passports

A further measure we might well undertake now to promote a spirit of international cooperation would be the establishment of a world passport, which would be granted annually to a select list of nominees from all over the world. Such a passport would permit its holder to travel freely in lands of all member nations. A list of nominees for this honor would be prepared by a committee of participating nations, and the honor would be conferred only on those who received a unanimous vote of approval from all member nations. The list might include, for example, Nobel prize winners, outstanding artists, leaders in religion, in government, in science, in education, and in business. It could become a highly coveted award all over the world —a suitable mark of distinction for our public servants in every walk of life. Above all, it could promote a degree of mutual trust and understanding that might, in the end, help to halt the race for atomic arms and forestall a war that nobody wants.

A world in which restrictions on communication and on the travel of individuals has been minimized is one in which the combined intellectual and technical powers of many nations can be brought to bear in unison on common problems. We are aware of many problems that can be and should be attacked by an international effort. Even under the imperfect conditions of international communication that exist today, significant projects are under way, and important beginnings have been made on others.

International Cooperation in Science

There is the superb example of regional cooperation illustrated by CERN, set up by the European Organization for Nuclear Research. Here men of many nations gather together for a joint assault on the experimental and theoretical problems of nuclear physics. There is likewise the inspiring scope of the International Geophysical Year. When it opens, a great network of observatories will embrace the entire earth. Chains of weather stations strung out on three meridian lines from the arctic to the antarctic will chart the circulation of the atmosphere during the intense period of activity spanned by the International Geophysical Year. All of the modern instruments of meteorology and geophysics will be mobilized in a global accumulation of data, which should provide the basis for years of analysis, speculation, and debate. The final reduction to conclusive findings will mark a new step in man's understanding of his global home.

There is the World Health Organization, which through its many laboratories and agencies is waging successful war against the diseases of mankind and is promoting in the less fortunate areas of the world new understanding of medical care for infants, for the aged, and for the handicapped.

In the Atoms for Peace Program, there are more than 25 bilateral agreements between the United States and countries less advanced in nuclear technology.

There is a multitude of activities supported by UNESCO: its educational training centers, its support of travel for scientific and cultural reasons, its contribution to the European Organization for Nuclear Research mentioned in a foregoing paragraph, the creation of the International Computation Center at Rome, the conferences in arid-zone research, and the many less noticed activities of the Field Science Cooperation offices. The UNESCO 1954 participation in the U.N. Technical Assistance Programs amounted to 56 projects in 36 countries.

These are but some of the most evident international cooperative efforts that are bringing the benefits of modern science and technology to peoples around the world.

Goals for World-Wide Effort

I have reviewed briefly both the positive and the negative steps toward increased collaboration among scientists of different nations, as they have developed in recent years. Now let us glance at a few fields in which joint efforts may prove especially beneficial.

As a prime example of a project that involves a subject that clearly has no relevance to national boundaries, we may think of climate control or world-wide weather modification. Recent advances in meteorology suggest that efforts in this direction may produce useful results sometime in the future. Yet evidently the control of amounts of precipitation, directions of winds, and like matters, are not properly planned by a single national power or even by two or three in regional collaboration. For instance, I believe that much of the weather of the United States is made along the coast of Alaska, in the Gulf of Mexico, or out in the Pacific, and my country has little or no control of the sea areas involved. Any regional effects on climate will have, perhaps, attenuated effects on climatic conditions in most distant areas. Moreover, such information as we now have strongly implies that the most effective weather control requires coordinated efforts over vast areas of the earth's surface, and the broader the cooperation, the greater might be the results.

Another example on a large scale that inevitably crosses national boundaries is the project to send a rocket into outer space. Purely from a geographic viewpoint, efforts to send missiles and ultimately passengers to the moon and the nearby planets are of world-wide interest. Although the intensely nationalist feelings characterizing international relations on our planet at the present time suggest that we may even see, as a result of interplanetary travel, an extension of the competitive colonialism that the last century saw for the backward areas of this planet, the prospect of seeing different sections of Mars staked out by different national governments of this earth seems on the face of it ludicrous. Are we trying to play God and develop a new planet in our own image and likeness? A much more rational and probably more productive basis for the exploration and development of other worlds would be under an organization that properly reflects the

common interests of all the peoples of this earth in such development. The man in the moon belongs to the children of every country, is a part of their dream-world, and, if it is reached by space ship, might better remain the property of all.

Returning now, however, from the fanciful and the future to the more immediate problems of initial efforts to get a space ship away from the earth, we recognize hazards of a rather severe sort that may arise as a result of the erroneous function of a space missile intended for the moon but, instead, through defective mechanism or planning, lands on the territory of another nation. If such a nation were at that time in an advanced state of tension in anticipation of a possible attack, this simple error might touch off the spark of world conflict.

This brings me to the competitive race to develop an intercontinental ballistic missile. We in the American Congress have already learned that it would be a drain on all of our budgets if this race should set a pattern in the whole field of space conquest. The U.S.S.R. and this country are working at high speed toward the attainment of an intercontinental ballistic missile, called by many "the ultimate weapon." Yet if the missile were to be attained almost simultaneously and prove to be as accurate as now forecast, if indeed it could carry atomic warheads with a striking power of several kilotons and place them within the area of a small circle, then no city in the world would be safe, no jet interceptor could police the skies, and no highway could promise egress from the affected area. In that day, the people of the earth would banish the weapon, as poison gas was outlawed in World War II, but only after the expenditure of fantastic sums of money, materials, and scientific skills.

Might it not be better to examine the chance to use space conquest as another project for an international laboratory? If we will never use this weapon once we achieve it, might it not be set aside as one segment of world-wide competition that could be surrendered to the effort to halt the race for a full arsenal of atomic arms in every land? Or must everyone carry his own six-shooter constantly strapped to his belt?

A third area might be research on the problem of controlling thermonuclear reactions in such a way that they would produce useful power. Many of my readers know far better than I the great amount of energy that may be released in the fusion of the lightest elements to form helium. The great abundance of heavy hydrogen, or deuterium—the great quantities of this valuable isotope that are contained in the world's oceans—leads to a staggering picture of energy available to lift the yoke of labor from men's shoulders throughout all the world. It has been estimated that the amount of heavy hydrogen in the oceans is sufficient to meet world power needs at 1000 times the present rate of consumption and for the next million years.

There seems to me to be no other field of technology today in which there is more evident need for pooling all the imagination and ingenuity that the world's scientists can bring together. The riches for mankind that must flow from the solution of these problems are without parallel. The history of science dramatizes again and again that problems of special difficulty are most usually solved by the cross-fertilization of ideas from diverse sources. The effort of any one country to develop controlled thermonuclear reactors in a unilateral manner under the secrecy required by an attitude of competitive nationalism must certainly have the effect of retarding the progress of such a country in this vital field.

As many scientists have been saying repeatedly, science cannot flourish under secrecy. The essence of the scientific process is the exchange of ideas—the comparison of procedures and the development of new ideas and techniques in an active atmosphere of collaboration in which many people may contribute small parts of the solution to produce a whole far greater than the sum of the parts. No one can yet say that the immense problems associated with development of controlled thermonuclear power will be capable of solution. What we can say, certainly, is that if their solution is available to man, then it will be most readily available and perhaps only available in an atmosphere of vigorous collaboration built upon the genius of many people from many lands. It would seem that the enlightened self-interest of all technologically advanced nations would best be served by their contributing heavily to the creation of a joint world laboratory in which the solution of these problems is sought jointly by scientists from many nations.

Security through Free Communication

Some secrecy-minded individuals may object that the technology associated with each of these fields I have mentioned has possible military applications. This claim is perfectly true; however, it does not necessarily follow that the security of different nations will be furthered by developing these fields under the military security system that our competitive nationalism has imposed upon science in recent years. In fact, it may be just because of the possible military applications from these new technologies that we shall wish to develop them jointly with all principal powers participating in world laboratories created for the purpose. Perhaps we can learn an important lesson from our experiences in the development of atomic energy. The unilateral development of the field of nuclear technology has created the following dilemma. Assuming the universal desire of all peoples to achieve some sort of workable disarmament, we have, nevertheless, in the development of nuclear technology greatly accentuated both the need for, and the difficulty of, attaining disarmament. Whereas modern atomic weapons raise the destructive potential of war to a new level, the suitability of atomic weapons for concealment and surprise use has, at this advanced stage in the competition, made disarmament by mutual inspection very difficult, if not impossible.

This experience in the field of nuclear technology suggests that similar potentialities exist in as yet undeveloped technologies. Research into the killing diseases of man with the objective of eliminating these diseases may bring us, instead, new ideas on how we may visit death on opposing populations by new species of bacteria. Or we may find a new type of rust that will destroy the opponent's feed grains, or a virus that will kill his livestock. Successful travel in outer space will suggest new, more effective, and even less detectable means of attack on other nations. Unilateral success in the field of climate control will suggest important new schemes for military action against the unfriendly powers. Project Sherwood for the development of controlled thermonuclear reactors provides the greatest promise on the horizon today of immense, inexpensive energy sources. Yet in the event of success for this project, it takes no advanced military technician to realize that such energy sources would have great applications in the engines of war. Thus we are led to feel that in every area in which the scientific method has enabled the intelligence of man to gain new mastery over nature, we face the possibility of an added complication in future disarmament efforts.

It is to this problem that I have directed these words. If the great powers find themselves in an atomic stalemate today—and I think they do—it is a carry-over of patterns of "national security" which modern science has rendered obsolete. The military techniques that might emerge from the new areas of technology that I have discussed can make the stalemate no worse. Already it is at a level in which any major power can precipitate almost total destruction upon an adversary (and in return upon itself) if it should make so tragic an error in judgment. Yet there is the danger that if these new areas of technology are developed in secret, some nation, which at some future time may be led by reckless rulers, may

feel that it has gained so great a lead in some field of science that it may dare to launch an attack for world conquest. Although this error in judgment will almost certainly be answered by mutual annihilation approaching totality, every effort must be bent while we still have the chance to prevent such dreadful miscalculations from occurring. Scientists, it seems to me, might suggest to the statesmen that modern technology could make the greatest contribution to the security of great powers if statesmen would move as far as possible from the secret competitive development of technologies under which we have largely operated in recent years. The scientists might urge, indeed, that the race for atomic arms could best be halted by having new fields of science developed jointly by all nations.

Responsibility for World Cooperation

The responsibility for carrying forward the proposals here made for cooperative studies of weather modification and for world laboratories of science must be placed with some international organization. A natural agency for this purpose is the United Nations. Such responsibility, such new avenues for accomplishing good, will strengthen and expand the capacity of the United Nations for reaching its goal of creating a world at peace.

The procedure for putting into effect ideas of this kind must fit the pattern of life in each land, and therefore what we will need first will be suggestions for possible courses of action. I hope they will be forthcoming. For my part, I intend to discuss the question with my colleagues in the U.S. Senate.

If we do succeed, no nation can then make the fatal error of assuming that it has an overwhelming technical lead over a possible adversary. The recent International Conference on the Peaceful Uses of Atomic Energy in Geneva illustrated how similar the achievements were in different nations, even though each had pursued its program of research and development in careful secrecy. Such similarity of development will no doubt be the case in the future on arms as well as on peaceful atoms.

My own experience at Geneva persuades me that many nations know a lot about the atom. When India's Homi J. Bhabha opened the "pie" of thermonuclear power, the blackbirds from four and twenty lands began to sing! What was secret at breakfast was table talk at lunch. Nations rushed to hold press conferences and attend activities. Is it not possible that there might be a similar pattern in weapons, and that no one nation holds all the cards?

Something new seems to be needed in this disarmament business. The nations make little headway in finding grounds for agreement on reducing the size of armies or destroying parts of atomic stockpiles. Very well; why not try to think constructively about disarmaments in potential weapons, in "ultimate weapons." The problems here are simpler because no one nation has so strong a vested interest in the new field that it will be contributing much more than valuable scientific help. It would be a new try at disarmament, this "disarming the future," and it would lack some of the defects of proposals for present disarmament.

This is not a suggestion that all nations pool their efforts in the field of present atomic technology, or a hint that the testing of atomic weapons be stopped by any of the great powers, and surely it is not a proposal that Oak Ridge, Hanford, Livermore, and Los Alamos be leveled to the ground. It springs rather from the feeling that the new technologies may displace the old, and that a war-weary world might achieve in time a form of disarmament by obsolescence.

If and when that day should dawn, each new technology would no longer be a source of dread power to be somehow kept from destroying us in the convulsion of global war. Rather, it would become what men of science have always intended—a means for opening up a new dimension in human life for defining a greater destiny for the forward course of the human spirit.

Note on Absolute Chronology of Human Evolution

Cesare Emiliani

Pleistocene temperature variations of equatorial, tropical, and temperate marine surface waters were recently investigated by means of oxygen isotopic analyses of pelagic Foraminifera from deep-sea cores (*1, 2*), using a method that was devised by Urey (*3, 4*) and developed by Epstein, Urey, and coworkers (*5, 6*). A time scale since the Günz glacial age was established on the basis of Washington radiocarbon dates of deep-sea cores by Rubin and Suess (*7, 8*), on ionium dates from other deep-sea cores by Urry (*9, 10*), and by comparison with the insolation curve for the 65°N latitude as recalculated by Brouwer and van Woerkom (*11*). This time scale is only a tentative one because it is impossible at present to date reliably the lower parts of the cores, but it is probably correct within about 20 percent.

Temperature Variations and Correlation with Continental Events

A generalized temperature graph for the Caribbean Sea has been published, based on the two stratigraphically longest cores that offer a good temperature record (*1*). The two cores were raised in the Caribbean Sea by Ewing, director of the Lamont Geological Observatory of Columbia University, and his associates; they were selected from among more than a thousand Atlantic and Caribbean cores and kindly sampled and made available by Ericson. The temperature graph is reproduced in Fig. 1. Temperature variations in higher latitudes were considerably greater (*2*), but the trend is apparently similar. Thus, the temperature graph of Fig. 1 is believed to have general stratigraphic value.

The classic alpine terminology is shown in the lowest division of Fig. 1. The absolute chronology in thousands of years before the present (B.P.) is shown in the second division. This chronology is considerably shorter than the chronologies usually suggested in the literature. If correlation between core stages and continental stratigraphy is correct (*1*), the Pleistocene time since beginning of

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the Günz age appears to be only about 300,000 years. An approximately equal interval separates the beginning of the Pleistocene, as recognized in a Pacific deep-sea core, from the Günz (*1*).

Fossil hominids, whose stratigraphic positions in the continental column are reasonably certain, are shown in the fourth and fifth divisions of Fig. 1 at chronological levels that are presently considered to be most probable. Cultures are shown in the two uppermost divisions.

Boundary lines separating various fossils or fossil groups and various cultures are an obvious schematization presented for convenience. These lines should be considered transitional zones of varying durations, and their positions on the time scale may be different in different areas.

Correlations between the temperature curve and continental stages, as shown in Fig. 1, are considered reasonably certain back to the Riss-Würm interglacial age. Consequently, the chronological levels of fossils and cultures are believed to be correct back to about 100,000 B.P. The position of the Swanscombe remains is also probably correct (*12*), but those of earlier fossils are largely conjectural.

Figure 2 shows a generalized temperature graph based on oxygen isotopic analyses of pelagic Foraminifera from deep-sea pilot cores (*1*). These are short cores devised to sample the top few decimeters of bottom sediments, and were raised in the equatorial Atlantic by Kullenberg, of the Oceanografiska Institut of Göteborg, during the Swedish Deep-Sea Expedition 1947–48 directed by Pettersson. As in the graph of Fig. 1, temperature refers to superficial equatorial water, and the variations were certainly greater and more complex at higher latitudes (*2*). The detailed temperature record of the pilot cores may have been somewhat smoothed by reworking of sediments by bottom animals (*1*), but the trend is believed to have been preserved.

The beginning of the last temperature rise is thought to have occurred approximately 16,500 years ago. This figure is based on Washington radiocarbon dates of Rubin and Suess on Caribbean, Atlantic, and Mediterranean cores (*7, 8*) and on ionium measurements by Urry on Atlantic, Caribbean, and Pacific cores (*9, 10*). The last altithermal and the Fennoscandian (= Mankato) and Allerød (= Two Creeks) substages are shown in Fig. 2 by only minor temperature variations, and the Pomeranian (= Cary) is not clearly indicated in any of the pilot or longer cores (*1*). Thus, the aforementioned glacial substages appear to represent only ice readvances that were superimposed on a general trend of ice retreat (*13*).

Evolution of Man and Human Cultures

The approximate durations of the human cultures, as shown in Figs. 1 and 2, are summarized in Table 1. According to the chronology of Fig. 1, *Homo sapiens sapiens* is more than 50,000 and less than 100,000 years old, if the Fontéchevade remains are ancestral and are assigned to a different subspecies (compare *14*).

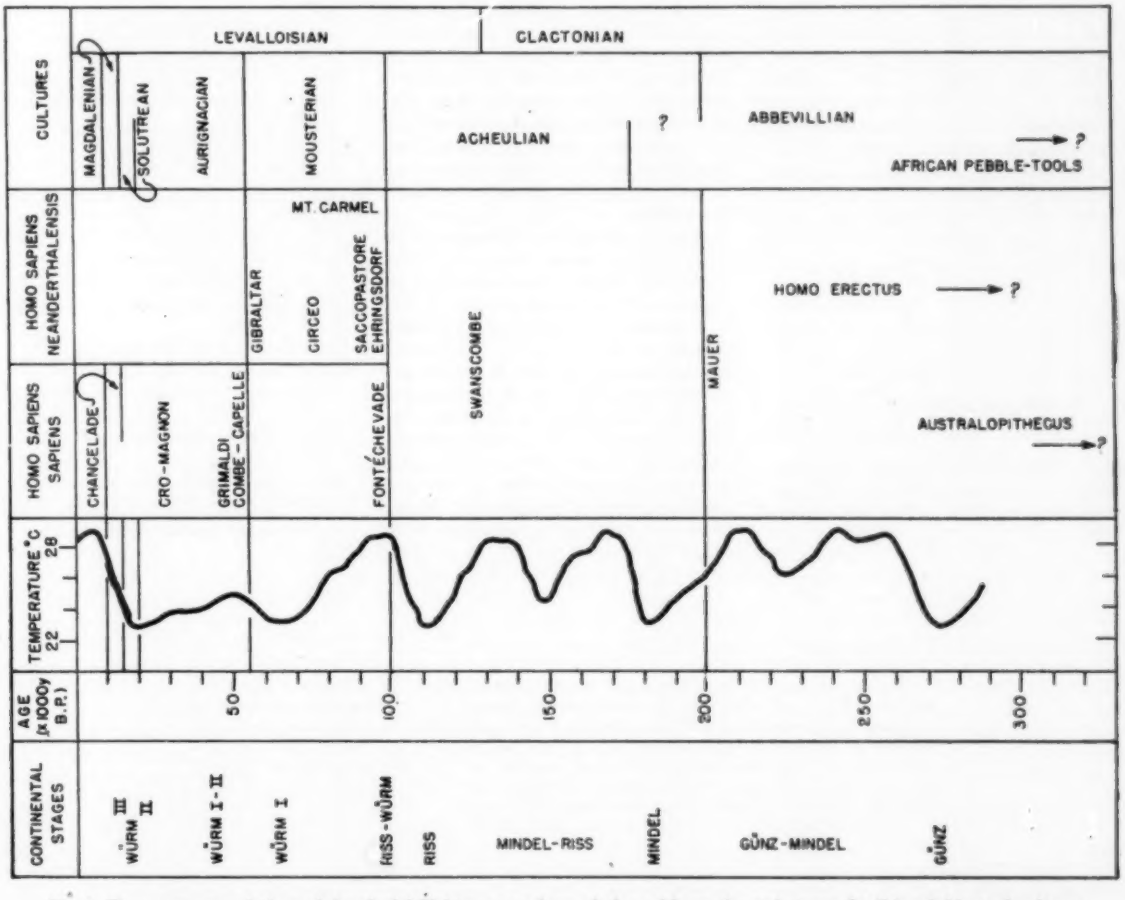

Fig. 1. Temperature variations of the glacial Pleistocene and correlation with continental stages, fossil hominids, and cultures.

On the other hand, if the *sapiens* subspecies is extended to include the Fontéchevade remains, its age is increased to at least 100,000 years, and even more if the Swanscombe skull bones are also included (*15*). Thus, the age of modern man is a problem of taxonomy as well as of dating, and its definitive solution may have to wait until more fossils have been discovered in the time interval between 50,000 and 150,000 years before the present.

"Classic" Neanderthals existed for only about 25,000 years, or about 1000 generations. If the Mount Carmel population was mutant rather than hybrid, the evolution of *Homo sapiens neanderthalensis* took about 50,000 years, involving about 2000 generations.

The surprisingly rapid evolution of the Neanderthals may indicate a more remarkable ability of *Homo* to speciate than hitherto has been suspected, and makes descent of *Homo sapiens* from *Australopithecus* through *Homo erectus* more probable. Oakley's objection that *Australopithecus* was not a tool maker and that the oldest known *Australopithecus* is not geologically old enough to have been the ancestor of the earliest pebble-tool maker (*16*) may be countered by observing that even if the first assumption is correct, which is not certain, the oldest known *Australopithecus* was almost certainly not the first in existence. In addition, the apparent ability of *Homo* to evolve rapidly, together with the rather uncertain stratigraphic relationship between pebble-tools and *Australopithecus* fossils, may not disprove descent of *Homo* from the latter. Finally, as pointed out by Robinson (*17*), such descent does not imply that all representatives of *Australopithecus* were older than *Homo* or that all representatives of *Homo erectus* were older than *Homo sapiens*. Partial coexistence is probable.

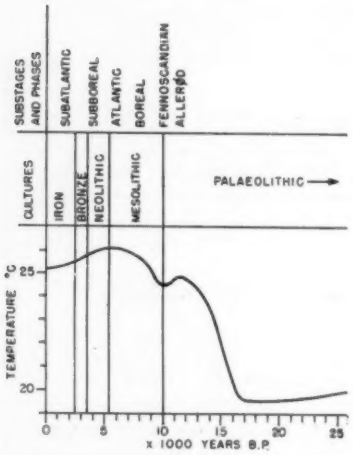

Fig. 2. Temperature variations since the beginning of the last deglaciation and correlation with geologic and cultural stratigraphy.

Table 1. Approximate durations of the cultures shown in Figs. 1 and 2.

Culture	Approximate duration (years)
Iron	2,500
Bronze	1,000
Neolithic	2,000
Mesolithic	4,500
Magdalenian	5,000
Solutrean	5,000
Aurignacian	35,000
Mousterian	45,000
Acheulian	75,000(?)
Abbevillian	100,000(?)

Many "missing links" have now been found, and absolute dating of these Lower and Middle Pleistocene fossils is important if a clearer picture of human evolution is desired. Such dating for many if not most of the fossil hominids now appears feasible if the following steps are taken: (i) oxygen isotopic analysis of Caribbean or equatorial Atlantic cores that are stratigraphically longer than those now available and that reach into the Pliocene; (ii) oxygen isotopic analysis of equally long Mediterranean cores (an attempt to raise such cores will be made by the Lamont Geological Observatory in the summer of 1956); (iii) correlation of the paleotemperature curves of the two sets of cores in order to establish a general deep-sea stratigraphic record covering the whole Pleistocene epoch and to connect the marginal Mediterranean record with the more representative Caribbean and equatorial Atlantic records; (iv) pollen analysis of Mediterranean cores and correlation of pollen profiles with paleotemperature curves (pollen is present in Tyrrhenian cores, as shown by Larsson, *18*) and as mentioned by Tongiorgi, *19*); (v) pollen analysis of a large number of continental sections, especially the Villafranchian of Italy and the African and Asian sections that are related to hominid localities; (vi) correlation of these continental pollen profiles with the Mediterranean profiles and, thus, with the general deep-sea record.

When this is done, it may be possible to determine absolute dates for the fossil hominids and also for the associated faunas, and to view from safer grounds the evolution of vertebrates during the Pleistocene and the emergence of man.

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Original thinkers and investigators do not therefore represent the only type of university professor. They will always be the distinguished figures; theirs will usually be the most profound and far-reaching influence. But even universities, modern universities, need and use men of different stamp—teachers whose own contributions to learning are of less importance than their influence in stimulating students or their resourcefulness in bringing together the researches of others.—ABRAHAM FLEXNER, *Universities—American, English, German* (Oxford University Press, New York, 1930), p. 6.

News of Science

Blood Groups in Physical Anthropology

In 1950 W. C. Boyd prophesied, in his book *Genetics and the Races of Man*, that physical anthropology, in its effort to get closer to the genes that distinguish the varieties of mankind, would tend to forsake the study of bones and skull shapes, skin color and hair form, and would focus more and more sharply on the blood groups as the best of known genetic characters to use in order to detect the heritable differences between populations and the shifts in gene frequencies that result from migration and from hybridization, genetic drift, and selection. Although there was some outcry from more conventional anthropologists at such an extreme point of view, there has in truth been in the past 6 years a veritable flood of anthropological publications dealing with the blood groups. To be convinced of this, one needs only to take a look at Mourant's comprehensive volume on *The Distribution of the Human Blood Groups* (1954) and to note the 1716 papers in this field that are listed in the bibliography as having been published since Boyd's monograph of 1939.

Another, perhaps more interesting way of noting the current activity in the anthropological study of the blood groups is to examine recent journals for contributions on the subject. *Nature*, on 7 Jan. 1956, published three reports in that single issue dealing, respectively, with the blood groups of the Carajás Indians of Brazil, with the occurrence of the new Diego blood factor in Venezuela, and with the presence of the same factor in Brazilian Indians. It is a distinct relief to learn that the high frequency of blood group gene *B*, once reported to exist in the Carajás Indians, and so inexplicable in American Indians, who characteristically lack *B* entirely, has now been shown by P. C. Junqueira and P. J. Wishart to be a false deduction from slide tests that yield dubious results. More accurate modern methods show no *B* at all in these Indians, although there is about a 50-percent frequency of Duffy positives among them.

The new Diego factor, which was discovered in 1953 in Caracas, is now found to be extremely rare in U.S. whites. Its frequency in the urban populations of Venezuela is low (2 to 4 percent), and it is not common in Venezuelan Negroes (7.3 percent) or Arawaco Indians (5.3 percent); however, it is extraordinarily common in the Carib Indians (35.5 percent) and in the Kaingángues and Carajás Indians of Brazil (46 percent and 36 percent, respectively). The two latter tribes, although they belong to the same linguistic family, live about 1000 miles apart. The two teams of workers reporting these studies consisted, respectively, of Philip Levine and his U.S. and Venezuelan collaborators, and of P. C. Junqueira, four Brazilian colleagues, and Hans Kalmus of the Galton Laboratory, London.

Recent issues of the *American Journal of Physical Anthropology* have carried a number of papers on the distributions of blood group genes. In the June 1955 issue Bruce Chown and Marion Lewis extended their studies of the frequencies of blood group and secretor genes in the Blackfoot Indians of Alberta to include the Stoney and Sarcee Indians. The separation of pure-blood and mixed groups offers valuable evidence of the trends and amounts of intermixture.

In the same issue M. Lewis, B. Chown, and R. F. Peterson reported on the distribution of the Kell-Cellano group among the white individuals of Manitoba; and C. S. Lacaz *et al.* gave the incidence of the Kell factor in the population of São Paulo, Brazil. In spite of ethnic differences, the *k* allele has an almost identical frequency in these two populations: 0.9643 in Manitoba; 0.959 in São Paulo. Chown and Lewis have also reported on the frequencies of the blood group and secretor genes in the Blood Indians of Alberta (*Am. J. Phys. Anthrop.*, Sept. 1955), and in doing so have turned up the fifth Indian tribe in which the rare Rh allele *cdE* is present.

In the same issue Jean Hiernaux has dealt with the puzzling variations in frequency of the sickling hemoglobin gene in the Belgian Congo and other regions of Africa. Rejecting the hypothesis of an extremely high mutation rate to keep the detrimental gene at a high level in certain populations, he argues that there must be an equilibrium between a favorable action of the gene when it is heterozygous and an unfavorable one when it is homozygous, although possibly genetic drift has also played a part in locally preserving it and increasing its frequency. The center of origin of the gene cannot be determined at present, because of the instability in the frequency of the gene and the great amount of intermixture between populations high in its frequency and others low in its frequency. Hiernaux is reserved toward the Veddoid theory of origin of the sickle-cell gene recently proposed by Lehmann, and he rightly points out that the introduction might as well have gone in the other direction. The absence in the Veddoids of India of the R^o allele, so very characteristic of all Negro peoples, denies a close relationship between Negroes and Veddoids, whichever way the gene for sickling went.

R. T. Simmons, J. J. Graydon, and other coworkers have for some years been engaged in a vast survey of blood-group frequencies in the Australasian and South Pacific areas. To date they have covered various Polynesian groups, such as the Maori; Melanesians, such as the Gilbertese, Fijians, Admiralty Islanders, New Hebrideans, and New Caledonians; Micronesians, such as the Palauans, Trukese, and Kapingas; Indonesians; Australian aborigines; Siamese; and even the Chenchu from southern India and the Ainu from Hokkaido, Japan. The latest in their series of papers (*Am. J. Phys. Anthrop.*, Dec. 1955) is an addition to the Polynesian studies—the Cook Islanders. The frequencies found in the latter confirm the distinctness of Polynesians from other Pacific islanders, and also indicate that the Cook Islanders differ from the Maoris by having some Melanesian admixture. The Polynesians show a basic blood-group relationship to the American Indians and Mongoloids rather than to Melanesians, Micronesians, or Indonesians.

Another interesting study reported in the December issue of the *American Journal of Physical Anthropology* deals with the blood groups of the Hottentots. A. Zoutendyk, A. C. Kopec, and A. E. Mourant, who previously have reported on the blood groups of the Bushmen, have collected data which show that the Hottentots are very similar to the Bushmen but different in some respects. R^o has a frequency of 68 percent in Hottentots, a value high but not so high as in the Bushmen (80 percent). *B* (19 percent) is higher than in Bushmen or any South African Bantu populations. The frequency of the Henshaw gene in Hottentots is the highest known (5 percent). The Lutheran gene, which in other Negro peoples approaches the European frequency (4 percent), is absent in Hottentots and Bushmen. Thus, while both

Hottentots and Bushmen show an "essentially African picture," the deviations are not the same in the two groups.

In two communications in the December 1955 issue of the *American Journal of Human Genetics*, D. F. Roberts and I have independently reestimated the amount of white admixture in the present composition of the U.S. Negroes by using the newer blood-group data from Nigeria and other parts of West Africa supplied chiefly by Mourant and his coworkers. Roberts arrives at an estimate of 20-percent white admixture in the Negro gene pool, with a gene flow from the white into the Negro gene pool of 0.02 to 0.025 per generation during the past 250 to 300 years. I have obtained a slightly higher estimate (about 22 percent) or, if the anomalous D^u frequencies in the West Africans are considered as derived from D, an amount of 28 or 29 percent. I have also used recent data on blood-group frequencies in presumably pure American Indians to see whether Indian admixture exists in the present U.S. Negro gene pool. The evidence is reasonably clear that there is no statistically significant component of that origin within the groups sampled.

The number and geographic distribution of such anthropological studies as these—this brief survey makes no pretence to completeness—strikingly demonstrates the activity of the field and the strong new trend in physical anthropology.

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U.N. Committee on Radiation Effects

The United Nations Scientific Committee on the effects of Atomic Radiation has ended its first series of meetings. For approximately 10 days the committee discussed in detail the scientific problems involved in carrying out the mandate of the General Assembly that it examine the "effects of radiation on man and his environment." Working groups considered seven topics: genetics, the effects of irradiation by internally absorbed isotopes, the effects of external radiation, natural radiation background, exposures during medical procedures, occupational exposure, and environmental contamination.

It was pointed out that, in the field of genetic effects, for example, sufficient information on which to base definite conclusions is not available. Before making recommendations, the committee has asked the Secretariat to collect by 1 Aug. from U.N. member states and from specialized agencies preliminary measurements of natural radiation background and of environmental contamination caused by man-made radioactivity. Specific information on local geographic, geophysical, and demographic conditions will be studied to see if any correlation in biological changes can be obtained from areas with different levels of natural radiation background. Methods of estimating the biological effects of small doses of radiation are also considered essential, and the committee has requested August reports on these, too. The committee's next meeting will take place in October.

Other information that the committee plans to collect on the effects of irradiation will come from various sources. Among these are patients who have been treated with radiation or who have undergone repeated radiological examinations and workers who have been exposed to these hazards in their occupations. For all people whose work exposes them to ionizing radiations, the committee has recommended the maintenance of continuing personal files that would include information from periodic medical examinations. The committee has also decided to establish a means of speedy collection and examination of information on any accidental overexposure.

In addition to requesting measurements over the surface of the earth of radioactive fallout, the committee has also asked for information on the amount, distribution, and composition of radioactivity that still remains in the upper atmosphere. Part of this activity falls on the earth each year and is thus a continuing source of possible increases in radiation levels. However, data available to the committee at this time from India, Sweden, the United Kingdom, and the United States indicate that fallout to date is only a fraction of the natural background.

Although it is calling for information almost immediately in several scientific areas, the committee recognized that standard procedures of measurement have not been formulated and accepted internationally. It has been decided to distribute information on known procedures of measurement as quickly as possible. At the same time, the committee will study and compare these procedures prior to its next meeting with the hope that internationally acceptable standards can be established without delay.

U.S. Technical Education

The following facts about the state of technical education in this country were included in recent testimony before the Research and Development Subcommittee of the Joint Congressional Atomic Energy Committee.

The number of trained engineers in the Soviet Union increased from 41,000 in 1920 to 541,000 in 1954, a 1300-percent rise. In the same period, the United States increase was from 215,000 to 500,000.

The number of engineering graduates from Soviet higher institutes rose from 28,000 in 1950 to 63,000 in 1955. In the same period, the number of United States engineering graduates dropped from 52,000 to 23,000.

The Soviet Union is graduating 120,000 engineers and scientists every year to this country's 70,000. Our new crop of graduate engineers is already only half of the 45,000 to 50,000 we need each year within our own national boundaries.

The number of qualified teachers of science and mathematics in United States high schools has dropped 53 percent in the last 5 years, while high-school enrollment has increased by 16 percent. And even this gives a misleading impression, because not more than half of the qualified teachers in these fields actually go into teaching.

Fifty-three percent of all high schools in the United States do not teach physics and only half of the high schools teach chemistry. In addition, a recent survey indicates that between 250,000 and 400,000 United States high-school students are taking their mathematics and scientific training from teachers who are not qualified to teach these subjects.

News Briefs

■ The Bureau of Economic Research and Statistics of the American Dental Association estimates that there are 97,529 dentists in the United States, one for each 1667 persons. The figures are based on the 1956 *American Dental Directory*, which was issued recently by the association.

The survey of the dental profession indicates that there are 1646 more dentists than last year, when it was estimated that there was one dentist for each 1669 persons, and 3803 more than in 1954, when the ratio was one dentist for each 1677 persons.

■ Another coelacanth [**122**, 868 (4 Nov. 1955)] was caught on 4 May off the Comoro Islands, between Madagascar and the African mainland. It is 6 feet, 6 inches long and is believed to be a female. A military plane was dispatched from Tananarive, Madagascar, to bring the fish back to local laboratories before it could decompose. Only one other female coelacanth has been caught before.

■ Portugal hopes to establish by the end of 1957 a laboratory for nuclear physics that will include an experimental reactor and other research equipment.

■ R. B. Woodward of Harvard University has reported the total synthesis of reserpine, a tranquilizing agent used in the treatment of hypertensive, nervous, and mental disorders. The synthesis, which is described in a recent issue of the *Journal of the American Chemical Society*, follows less than a year after the chemical structure of the alkaloid was determined in laboratory studies by other chemists. Research associates in the work were three Swiss chemists, F. E. Bader, H. Bickel, and A. J. Frey, and a Canadian, R. W. Kierstead.

In the same issue of the ACS journal Frank L. Weisenborn and Patrick A. Diassi of the Squibb Institute for Medical Research report that working independently they, too, have achieved the synthesis of reserpine. A somewhat similar step has been described by Ciba chemists in the Swiss journal *Experencia*.

Scientists in the News

EDWARD U. CONDON, visiting professor of physics at the University of Pennsylvania, and a former president of the AAAS and of the American Physical Society, has accepted the post of professor of physics and chairman of that department at Washington University (St. Louis), effective 1 Sept. He succeeds GEORGE E. PAKE, who will become professor of physics at Stanford University next fall. Pake will in turn succeed W. E. LAMB, JR., 1955 Nobel prize winner in physics, who has accepted the chair of theoretical physics at Oxford University in England.

Another physics appointment at Washington is that of MICHAEL W. FRIEDLANDER of the University of Bristol, England. He will become a research associate with the task of establishing a nuclear emulsion group to study high-energy nuclear processes.

MELVIN CALVIN, professor of chemistry and director of the bio-organic division of the University of California Radiation Laboratory, has been awarded the 1956 Theodore William Richards medal of the Americal Chemical Society's Northeastern Section. The award is given biennially for outstanding achievements in research.

PAUL J. BRANDLY has been selected to head the newly formed biological control section in the Meat Inspection Branch of the U.S. Department of Agriculture, with headquarters at the Agricultural Research Center, Beltsville, Md. Almost his entire career has been spent in USDA poultry- and meat-inspection activities, and since 1952 he has served as food bacteriologist in the Meat Inspection Branch.

STANLEY S. BALLARD, research physicist at the Scripps Institution of Oceanography of the University of California, has been elected president of the International Commission of Optics for a 3-year term. The ICO is affiliated with the International Union of Pure and Applied Physics but in a semi-independent category. Its objective is to contribute, on an international basis, to the advancement of theoretical and applied optics, including the optics of the human eye. The commission now has 14 member countries: Belgium, Canada, Czechoslovakia, France, Germany, Great Britain, Italy, Japan, Netherlands, Poland, Spain, Sweden, Switzerland, and the United States.

JEAN OLIVER, emeritus distinguished service professor of pathology, State University of New York, College of Medicine, Renal Research Unit, Overlook Hospital, Summit, N.J., has been awarded the second Addis memorial medal of the Los Angeles chapter of the National Nephrosis Foundation. Oliver was recognized for his years of work on the anatomy of the kidney and for his pioneer ideas in correlating structure and function in that organ.

BERT E. CHRISTENSEN, a member of the faculty of Oregon State College for 25 years, has been named chairman of the department of chemistry at the college. At the close of the academic year he will succeed E. C. GILBERT, chairman since 1940, who will continue in the department in full-time teaching and research.

SAUL B. SELLS, head of the department of clinical psychology at the U.S. Air Force School of Aviation Medicine, Randolph Air Force Base, Tex., has received the Raymond F. Longacre award of the Aero Medical Association. Sells was honored for his work in developing a group of psychiatric tests that will reveal the future reactions of Air Force flyers to the stresses of combat missions.

LESLIE B. AREY, chairman of the department of anatomy and Robert L. Rea professor of anatomy at Northwestern University, will retire at the close of the current academic year. He will be succeeded in these posts by BARRY J. ANSON, a faculty member for 30 years. Arey will continue at Northwestern in a teaching and research capacity.

More than 600 colleagues and former students met this month at a faculty-alumni reunion dinner to honor Arey for his 41 years of service and for his contributions to anatomy. Best known as an expert on embryology, Arey wrote *Developmental Anatomy*, a textbook that is widely used in undergraduate and medical-school courses.

ERNEST KENNAWAY, English cancer specialist, arrived in this country on 7 May to lecture at the Sloan-Kettering Institute and at Harvard and Yale universities.

WILLIAM I. THOMPSON, chemical engineering consultant, has been named chief of process engineering for the General Dynamics Corporation's General Atomic Division, San Diego, Calif. His group will work on the design and evaluation of reactor systems and components.

ROBERT G. STONE, chief of the technical information and publications division at Air Weather Service headquarters, has received the American Meteorological Society award "for his many years of faithful editorship of the *Bulletin of the American Meteorological Society* and his active participation in committee council work."

The society's Meisinger award was presented jointly to ERNEST J. FAWBUSH, commander of the 29th Weather Squadron, and ROBERT C. MILLER, officer in charge, Severe Weather Warning Center, Kansas City, Mo. They were honored "for their pioneering studies of the genesis and the practical prognosis of tornadoes and other destructive local storms."

WARREN O. NELSON and ROBERT C. COOK have received the $500 Lasker awards of the Planned Parenthood Federation of America. Nelson is on leave of absence from his post as professor of anatomy at the State University of Iowa to serve as medical director of the Population Council. His citation pointed out that "his studies of the biology of spermatogenesis have made a fundamental contribution to the field of human reproduction. . . . In the past two years . . . he has concentrated his strong talents on the physiologic control of conception. Touring the world as a veritable ambassador of science, he has inspired, advised, and guided investigators all over the globe on the problems of reproductive physiology allied to population control." Nelson's research has included a series of studies that produced the classification scheme now used for diagnosis and treatment of various types of male infertility.

Cook, author of *Human Fertility: the Modern Dilemma*, and for 35 years editor of the *Journal of Heredity*, now makes his headquarters in Washington, D.C., where he directs the Population Reference Bureau, edits its publication, *The Population Bulletin*, and serves as a member of the biology department of George Washington University. He was cited for "his outstanding contribution to wider understanding of the world population problem."

JOSEPH A. GALLAGHER, clinical director at the U.S. Public Health Service Hospital at Staten Island, N.Y., has been appointed medical officer in charge of the Indian Health Sub-area Office in Anchorage, Alaska. He will be responsible primarily for the Anchorage hospital, a 400-bed medical center for native Alaskans. In addition he will serve as sub-area director for the Alaska Native Health Service in western Alaska and will be responsible for hospitals at Barrow, Bethel, Kanakanak, Kotzebue, and Tanana.

A. P. BLACK will retire as head of the chemistry department at the University of Florida on 30 June. He will be succeeded by HARRY H. SISLER, professor of chemistry at Ohio State University.

ISRAEL WECHSLER, clinical professor of neurology at Columbia University College of Physicans and Surgeons, delivered the annual Hughlings Jackson memorial lecture of the Montreal Neurological Institute.

DONALD W. LATHROP of the archeology department at Harvard University has left Lima, Peru, on an expedition to the forest region east of the Peruvian Andes. The expedition is being sponsored by the American Museum of Natural History of New York. Lathrop will carry out his anthropological and archeological studies entirely in the department of Loreto. At present he is in the Ucayali River region near Pucallpa, where he plans to spend from 6 to 8 months.

BERNARD L. HORECKER, chief of the section on enzymes and cellular biochemistry, National Institute of Arthritis and Metabolic Diseases, has been appointed visiting lecturer in biochemistry at the University of Illinois, Urbana, for the summer session.

ROBERT S. BRAY, who has served as deputy chief of the technical information division in the Library of Congress since July 1950, has been named chief of that division, which performs specialized reference services connected with technical and scientific literature, under contract to the Department of Defense.

HUGH R. WOOD, who has been dean of the medical school at Emory University for almost 10 years, has resigned that post to devote full time to his responsibilities as director of the Emory University Clinic, which he has headed since its establishment 3 years ago.

ARTHUR P. RICHARDSON, director of the university's Division of Basic Health Sciences, succeeds Wood in the deanship. CARL C. PFEIFFER, chairman of the department of pharmacology, has been named acting director of the health sciences division in Richardson's place.

Recent Deaths

C. BREWSTER BRAINARD, West Hartford, Conn.; 82; gastroenterologist; former assistant in the stomach clinic at Cornell Medical School; 7 May.

WILLIAM C. DUFFY, Hamden, Conn.; 57; professor of clinical surgery at Yale University; 4 May.

SAMUEL W. FERNBERGER, Philadelphia, Pa.; 68; professor of psychology at the University of Pennsylvania; 2 May.

LIVINGSTON E. OSBORNE, Chicago, Ill.; 71; former Illinois state director of conservation; 8 May.

HENRY SANGMEISTER, Penn Valley, Pa.; 66; obstetrician and gynecologist; former member of the faculty at the University of Pennsylvania and Hahnemann Medical College; 5 May.

MORRIS M. SLOTNICK, White Plains, N.Y.; 54; research mathematician and geophysical interpreter for the Standard Vacuum Oil Company of New York; 9 May.

Education

■ The Medical College of Virginia has opened a new isotope farm, which was sponsored by the American Tobacco Company at a cost of $120,000. Willard F. Libby, commissioner, U.S. Atomic Energy Commission, spoke at the dedication.

"Medicine today stands at the threshold of a major advance. . . . In the language of Physicists, [it] is just about ready for a 'quantum jump,' and it is my feeling that this will come about through the increased use of isotopically labelled drugs and medicinals.

"Isotope farming is the culture of biochemicals by raising plants and animals in an isotopically enriched environment such as an atmosphere of radioactive carbon dioxide. . . . In especially designed chambers such as those you have here in this farm we dedicate today, plants such as alfalfa, soybean, buckwheat, rye, tobacco, foxglove, poppy, etc., have been cultured in a radioactive carbon dioxide atmosphere so that all of their substance has been labelled with radiocarbon atoms in proportions of a few atoms of carbon-14 for every million ordinary carbon atoms. These plants have served to produce a number of useful radiochemicals. . . .

"It has been well demonstrated already that the isotope farm products are of great value in biochemical and medical research. There is another possibility, however . . . namely, that doctors may come to you for radioactive-labelled medicines in normal medical practice for diagnostic purposes. . . .

"With the exception of oxygen and nitrogen, radioisotopes of most of the physiologically important elements can be introduced into living organisms by the farming technique. . . . With . . . five or six isotopes, plants and animals can be labelled for half of their elements and so serve as sources for all of the biochemicals. . . . Certainly there seems to be no doubt that one of the great benefits of the atom will be not only the use of isotopes in medical research, but their use in routine diagnostic practice."

■ To stimulate interest in industrial chemistry, the chemistry department at St. Olaf College is distributing 50 scholarships to high-school students throughout the Midwest so that they may attend the 4-day High-School Chemistry Institute that will begin at St. Olaf's on 11 June. The awards will defray the costs of room, board, and registration for the sessions. Scholarship winners for the institute are being selected by faculty committees from the participating high schools.

The institute, which is planned as the first in an annual series, will introduce the students to the growing opportunities in chemistry. While at St. Olaf, the group will have discussion sessions with instructors at the college, watch experiments, and tour the laboratory facilities. A field trip is planned that will permit the students to visit industrial chemistry departments in the Ford Motor Company, the Minnesota Mining and Manufacturing Company, and the General Mills Research Laboratories.

■ A schedule is available of the laboratory refresher training courses that will be offered between July 1956 and June 1957 by the laboratory branch of the U.S. Public Health Service Communicable Disease Center, Chamblee, Ga. The courses, which range from 1 to 4 weeks in length, deal with the laboratory methods in the diagnosis of bacterial diseases, parasitic diseases, viral and rickettsial diseases, and so forth.

■ The Government of Pakistan has opened a school for physiotherapists at the Jinnah Central Hospital in Karachi. The World Health Organization of the United Nations is helping the school with supplies, equipment, books, and other teaching aids. It also has helped to staff the school.

■ The Radio Electronic Television Schools, Montreal, Canada, has announced that it has been commissioned

to provide about 300 radar technicians to maintain the distant early warning (DEW) radar line in the Far North. The institution, which has ten schools, has signed an agreement with the Federal Electronic Corporation to provide the technicians for the year beginning in June. The corporation is a contractor for the U.S. Government, which is installing and maintaining the DEW line. A technician's salary is $800 a month, with a $1500 bonus on completion of a year's tour of duty.

Grants, Fellowships, and Awards

■ The National Science Foundation will award individual grants to defray partial travel expenses for a limited number of scientists who will attend the 15th International Congress of Pure and Applied Chemistry that is to be held in Lisbon, Portugal, 9–16 Sept. Application blanks must be submitted *by 1 July* to the National Science Foundation, Washington 25, D.C.

The foundation also has announced that a group of similar awards are available for the eighth International Congress for the History of Science and the fourth general assembly of the International Union for the History of Science that are to be held in Florence and Milan, Italy, 3–10 Sept. The grants will approximately cover the cost of round-trip air-tourist transportation. The foundation must receive applications *by 15 June*.

■ The grants for 1956–57 that were appropriated by the Engineering Foundation of New York at its recent annual meeting totaled $53,000. The funds will aid research programs that are receiving estimated outside support of $497,500. This work, which is sponsored by the major engineering societies, is being carried out primarily in university, government, and industrial laboratories.

The projects receiving funds represent all the major branches of the profession and range from a program for predicting disastrous storm surges, which got under way last year under sponsorship of the American Institute of Mining and Metallurgical Engineers, to a recently instituted 3-year study of the thermal resistivity of soils that is being cosponsored by the American Institute of Electrical Engineers and other groups.

■ The Dickinson Research Memorial, research division of the Planned Parenthood Federation of America, Inc., is interested in supporting basic research in the physiology of reproduction, with special emphasis on factors influencing fertility. For further information address the Dickinson Research Memorial, 501 Madison Ave., New York 22.

■ Applications by research investigators for support of studies related to the cardiovascular field are now being accepted by the American Heart Association. The awards would be for the fiscal year beginning 1 July 1957. Application deadline for research fellowships and established investigatorships is *15 Sept.* For grants-in-aid, applications must be made by *1 Nov.* Awards are made in the following categories.

Established investigatorships. Awarded for periods of up to 5 years, subject to annual review, in amounts ranging from $6000 to $9000 per annum, to scientists of established ability who have developed in their careers to the point where they are independent investigators.

Research fellowships. Awarded to young men and women with doctoral degrees for periods of from 1 to 2 years to enable them to train as investigators under experienced supervision. Annual stipends range from $3500 to $5600.

Grants-in-aid. Made to experienced investigators in varying amounts up to $10,000 to provide support for specified projects.

Further information and application forms are available from the Medical Director, American Heart Association, 44 E. 23 St., New York 10.

Miscellaneous

■ The International Commission on Zoological Nomenclature has recently announced a series of decisions on the names of certain birds. Applications to the commission were published in October 1952 in part 1/3 of volume 9 of the *Bulletin of Zoological Nomenclature*. Among the decisions, the following are of wide general interest: (i) suppression of the generic name *Colymbus Linnaeus*, 1758, and acceptance of the generic name *Gavia* Forster, 1788, for the divers (loons) and of *Podiceps* Latham, 1787, for the grebes (*Opinion* 401); (ii) validation of the generic name *Pyrrhocorax* [Tunstall], 1771, for the Chough by the suppression of the name *Coracia* Brisson, 1760 (*Opinion* 404); (iii) suppression of the specific name *ericetorum* Turton, 1807, and acceptance of the name *philomelos* Brehm, 1831, for the song thrush (*Opinion* 405); (iv) suppression for nomenclatorial purposes of the names by Linnaeus published in 1776 in the "Catalogue of Birds, Beasts, . . . in Edwards' Natural History" (*Opinion* 412); (v) validation of the name *Columba migratoria* Linnaeus, 1766, for the passenger pigeon (*Direction* 18); (vi) validation of the generic names *Bubo* Dumeril, 1806, *Coturnix* Bonnaterre, 1790, *Egretta* Forster, 1817, and *Oriolus* Linnaeus, 1766, by the suppression of older homonyms (*Direction* 21); (vii) acceptance of *Gallinago* Brisson, 1760, and rejection of *Capella* Frenzel, 1801, as the generic name for the snipe (*Direction* 39).

The foregoing *Opinions* and *Directions* are now in the press and will be published at an early date. All inquiries should be addressed to the Publications Officer, International Trust for Zoological Nomenclature, 41 Queen's Gate, London, S.W.7.

■ The works of the Elsevier Publishing Company of Amsterdam, the Netherlands, publisher of European scientific and technical volumes, are to be distributed in this country by D. Van Nostrand Company, Inc., Princeton, N.J. Van Nostrand will list from 15 to 20 new titles annually, with editorial emphasis on chemistry, engineering, and medicine and their related applications in industry and research. Elsevier, which has offices in London, Brussels, and Paris, publishes books in many different languages.

■ The U.S. Civil Service Commission has announced two new examinations, one for medical bacteriologists and one for agricultural research scientists. Full details concerning the requirements to be met and instructions for filing applications are given to each announcement. No written test is required.

Interested persons may obtain application forms from many post offices throughout the country or from any Civil Service office listed in the announcements, which may be obtained from the U.S. Civil Service Commission, Washington 25, D.C.

■ The U.S. Atomic Energy Commission has just issued an 817-page book, *Radioisotopes in Medicine*, which is the complete proceedings of a special course that was conducted by the Oak Ridge Institute of Nuclear Studies in September 1953. The book contains 48 chapters, divided into nine main sections, complete with bibliography, index, charts, and illustrations. The editors are Gould A. Andrews, Marshall Brucer, and Elizabeth B. Anderson of the ORINS medical division.

The volume contains papers on the availability and uses of isotopes, problems in radiation, radiation measurement and dosimetry, tumor localization, diagnostic and therapeutic uses of radioiodine, metabolic and vascular studies, isotopes in the study and treatment of hematologic disorders, therapy with radioactive colloids, and therapy with external and implanted sources. A paperbound edition may be obtained for $5.50 from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.

Reports and Letters

Factors in Human Milk Interfering with Influenza-Virus Activities

The recognition of mucoproteins and the isolation of N-containing saccharides in human milk stimulated the study of human milk as a source for factors with antiviral activity (*1*). Mucoproteins interfering with hemagglutination by influenza virus or exhibiting other antiviral activity have been previously found in various biological materials (*2*). In a recent report (*1*) from our laboratory, fractions obtained from human milk were described as showing activity against the multiplication of influenza viruses in the chorioallantoic cavity of the chick embryo.

Further investigations of the nature of these antiviral substances in human milk were undertaken. For these investigations the technique of Fulton and Armitage (*3*), utilizing pieces of chicken chorioallantoic membrane for infectivity titration of influenza viruses, was modified and adapted as a screening procedure for one form of antiviral activity—that is, inhibition of viral multiplication. Influenza-A strain PR8 was used.

It was noted that, in those fractions that showed antiviral activity, there was definite toxicity to the membranes at concentrations slightly higher than those showing antiviral activity. This was evidenced by a loss of elasticity and by a stretched and pale appearance. When these fractions were passed over a cation-exchange column, no antiviral and toxic effects were demonstrable in the filtrate. The material that was eluted from the column, however, showed marked toxicity and antiviral activity. This material was high in copper content, probably owing mainly to contamination during processing of the milk. It was decided, therefore, to test the activity of copper ions, and it was found that copper chloride showed antiviral activity at a level of 10 μg/ml with evident toxicity at 30 μg/ml. It was observed that the antiviral activity of the copper salt varied inversely with the concentration of the virus.

The effect of copper chloride on multiplication of influenza-A strain PR8 in the allantoic cavity of the embryonated chicken egg (10-day-old) was then studied. At a level of 1.0 mg of copper chloride per egg, the results paralleled those reported for the human milk factor (*1*). When the inoculum size of PR8 was 100 ID_{50}, growth of the virus was delayed at 24 hours but reached the same titer as that of the controls in 48 hours. When, however, the inoculum size was 10,000 ID_{50}, the viral titer that was reached after 24 hours in the presence of 1.0 mg of copper chloride per egg was the same as that of the controls. Further studies, with earlier and more frequent sampling, indicated, however, that temporary inhibition with copper chloride was also demonstrable with this level or even higher levels of virus. If the copper chloride was injected 24 hours before the virus, a delayed effect was still evident, although it was slightly less pronounced. At this concentration of copper chloride (1.0 mg per egg), there was no macroscopic evidence of toxicity to the embryo or the chorioallantoic membrane. At 3.0 mg of copper chloride per egg, death of the embryo resulted within 18 hours.

In conclusion, it appears that the copper ion interferes, even in extremely low concentration, with the multiplication of influenza virus in the chorioallantoic membrane. The antiviral activity of fractions obtained from human milk (*1*) was the result of contamination with the copper ion.

For the purification of substances that inhibit hemagglutination by influenza virus, skimmed human milk contained in cellophane casings was dialyzed against 10 vol of distilled water at +6°C for three periods of 2 days each. The dialysis residue was then adjusted to *p*H 6.0 to remove the casein and then was carefully concentrated in a vacuum to a volume suitable for lyophilization. The lyophilized products were then deproteinized by trichloroacetic acid at +6°C or by the method of Sevag. The deproteinized substances were subjected to an alcohol fractionation, as is indicated in Table 1. Hemagglutination inhibitor activity (HAI) was determined on the various fractions, using influenza-A strain PR8 and influenza-B strain Lee as indicator viruses. The virus was passed in 10-day-old chick embryos, and the infected allantoic fluid was harvested after 48 hours of incubation at 36°C and heated at 56°C for an additional 30 minutes. To 0.2 ml of twofold dilutions of the fractions in round-bottom test tubes 55 by 17 mm was added 0.2 ml of indicator virus containing 4 hemagglutinating (HA) units. Phosphate-buffered saline, *p*H 7.2, was used throughout the test. The tubes were shaken and allowed to stand at room temperature for 1 hour, after which 0.2 ml of 1 percent washed chicken red-blood cells was added. The tubes were again shaken and allowed to stand at room temperature for 1 hour, after which they were checked for hemagglutination. The highest dilution of the fraction tested that completely inhibited hemagglutination was taken as the end-point. The fractions were also analyzed for Bial positive material that has been reported to be present in many natural substances showing HAI activity (*4*). The Bial-positive material was reported to be gynaminic acid (*5*). The bifidus activity of these fractions was likewise determined. The results are given in Table 1.

HAI activity against indicator Lee virus was found only in the 50 to 60 percent ethanol fraction. No activity against indicator PR8 was demonstrated. Variation in the level of activity was observed with different preparations. Three preparations of the 50 to 60 percent ethanol fraction showed activity at 5 μg/HA unit of indicater Lee; other preparations showed activity as low as 250 μg/HA unit of indicator Lee. The gynaminic acid content, however, remained close to 6 percent in all these preparations. The 60 to 87 percent

Table 1. Results showing HAI activity with indicator Lee virus, growth-promoting activity for *L. bifidus* var. *Pennsylvanicus* and percentage of gynaminic acid in the human-milk fractions listed.

Preparation	HAI activity/HA unit indicator Lee (μg)	Activity for *L. bifidus* var. *Penn.* (1 unit in mg)	Quantitative Bial (% gynamic acid)	Yield (g)
Sevag deproteinized	0	1		5
0 to 51% C_2H_5OH	0	1.9		0.80
50 to 60% C_2H_5OH	5 to 250	0.50	6	0.13
60 to 87% C_2H_5OH	0	0.54	16	0.66
Residue	0	2.8		2.37

ethanol fraction, which contained 16 percent gynaminic acid, showed no HAI activity. This is in agreement with findings by Odin (*4*), showing that no quantitative relationship was found between the presence of Bial-positive material and the HAI of various substances. Growth-promoting activity for *L. bifidus* var. *pennsylvanicus*, however, was found in both the 50 to 60 percent and 60 to 87 percent fractions where the Bial-positive material was present.

The HAI activity of these preparations was lost on incubation with active Lee virus, active PR8 virus, and Vibrio cholerae filtrate (RDE). HAI activity was not lost on heating in boiling water for 10 minutes. These properties are similar to those of the Francis inhibitor of human serum.

In conclusion, it may be stated that the presence of normal hemagglutinin-inhibitor in human milk has been demonstrated.

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23 November 1955

Chlorosis Produced by Fluorine on Citrus in Florida

A chlorotic condition of citrus trees in the Bartow area of Polk County, Fla., was noted in April 1950. This chlorotic pattern was unique in that it differed from known chloroses resulting from nutritional deficiencies or toxicities. Although certain instances of typical iron, zinc, manganese, and other deficiency symptoms could be found in this area, the most prevalent pattern resembled the pattern on citrus that results from boron toxicity. However, there was no gumming on the undersides of the affected leaves, which is always associated with boron toxicity (*1*).

The appearance of this chlorosis seemed to be associated with a triple-superphosphate manufacturing plant that had recently been put into operation. Qualitative tests of citrus leaf ash from affected trees indicated the presence of fluorine. Shortly after this first observation of chlorosis, additional scrubbing facilities were installed at the triple-superphosphate manufacturing plant, and the chlorotic pattern on citrus was alleviated.

Fig. 1. Chlorosis of citrus leaves induced by fluorine.

However, in January 1954, several other instances of chlorosis were observed. This pattern, shown in Fig. 1, occurred in groves on several different types of soil, and under several different systems of management. As the number of new triple-superphosphate manufacturing plants in the vicinity has increased (there are seven at present), the extent of the area affected has also increased.

It is known that Florida pebble rock phosphate contains from 2 to 4 percent fluorine (*2*). In the production of triple-superphosphate, the rock is treated first with sulfuric acid, then with phosphoric acid, and in each treatment fluorine is released.

Analyses of citrus leaves in California (*3*) that had been obtained near an industrial plant indicated that up to 211 ppm of fluorine on a dry weight basis could be found in leaves from trees that were suspected of being damaged. However, no instances of chlorosis were reported. Chlorotic leaves from affected Florida groves ranged in fluorine content from 370 ppm to as low as 48 ppm. Chlorotic citrus leaves were observed up to 6 miles away from the nearest plant, but analyses of these leaves did not prove that the leaves were abnormally high in fluorine content. Thus, chlorosis was not in all cases associated with an unusually high fluorine content. It would appear that fluorine could cause leaf chlorosis, then be dissipated by translocation or otherwise lost, an observation similar to that made by others (*4*). Normal-appearing leaves away from the affected area contained from 12 to 30 ppm of fluorine.

Since the degree of chlorosis was not always related to the fluorine content of affected leaves, samples of an air plant, *Tillandsia usneoides*, commonly called Spanish moss, growing in the affected area, were taken at varing distances from one of the triple-superphosphate manufacturing plants and analyzed. The results of these analyses (Table 1) indicated that fluorine was being released by the plant operation. The deviations from the general trend can be ascribed to the topography of the area sampled.

During the spring of 1955, sprays of aqueous HF, H_2SiF_6, and H_3PO_4 were applied at a concentration of 0.1*N* to 4-year-old Ruby Red grapefruit trees located north of Lake Alfred, 20 miles away from the nearest triple-superphosphate plant. Approximately 1 lit of solution was applied per tree, per spray application. After the application of seven sprays during a 2-month period, a chlorotic leaf pattern appeared that was identical to the pattern observed in the affected area. This pattern occurred with both the HF and H_2SiF_6 sprays and was confined to the growth produced during the period of spraying. It appeared that the growth that was about three-fourths matured was the most susceptible to the fluorine injury. A similar observation was made in the area affected by the triple-superphosphate plants.

A small amount of leaf burn resulted from the H_3PO_4 spray, but no pattern appeared. Sulfuric acid sprays were not used because it had been previously noted that chlorotic leaf symptoms were present near one plant that produced defluorinated phosphate rock but did not operate a sulfuric acid plant.

It has been observed by others (*5*) that gaseous fluorine compounds are more toxic to many species of vegetation than are equivalent concentrations of sulfur dioxide and also that the greatest accumulation usually occurs at the tips or margins of leaves. This results in an inhibition of photosynthesis or degradation of chlorophyll. The reason chlorosis develops in Florida and not in California may be the result of differences in climatic conditions, primarily the higher

Table 1. Fluorine content of Spanish moss.

Distance from manufacturing plant (mi)	F (ppm)
0.20	9400*
1.5	688
2.5	688
3.5	888
4.0	132
5.0	110
6.0	60
7.0	100
20.0	100

* This sample was taken within 400 yards of the plant. It is likely that part of the fluorine present was in the form of rock and triple-superphosphate dust.

humidity under which leaves develop in Florida.

From the evidence obtained, it appears conclusive that the unique chlorotic leaf pattern on citrus that appears in association with triple-superphosphate manufacturing plants is the result of the fluorine evolved in the process of manufacture (*6*).

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18 November 1955

Photochemical Reactions of Nitrogen Dioxide and Hydrocarbons in Air

The principal chemical characteristic of Los Angeles smog is the presence of relatively high oxidant concentrations. The nature and genesis of the oxidant have been the subject of intense study during the past several years. Haagen-Smit and coworkers (*1, 2*) have investigated the photochemical reactions of a series of synthetic mixtures of nitrogen dioxide and hydrocarbons in both oxygen and air carriers. Concentrations of the reactants were in the range of parts per million. On irradiation from polychromatic sources, such as the sun or blue fluorescent lamps, oxidant was produced that was manifested by its ability to crack stressed rubber and to oxidize alkaline phenolphthalin reagent.

A verification of Haagen-Smit's findings was carried out in the course of our study of the photochemical reactions of trace constituents in the atmosphere (*3*). The purpose of this communication is to report the nature of the verifications obtained.

A series of experiments was run by one of us (A. M.) at California Institute of Technology laboratory of Haagen-Smit (*4*). A number of 5-lit flasks containing heptene-2 at 3 ppm and nitrogen dioxide at 0.1, 0.4, 1.0, and 3.0 ppm in humidified air were irradiated for 10 hours with a bank of Westinghouse 40-w fluorescent lamps. The flasks contained suspended strips of stressed rubber as oxidant traps (*5*). The degree of rubber cracking rose from zero to high values as a function of NO_2 concentration.

To determine the reproducibility of the quenching effect reported (*2*) at elevated hydrocarbon concentration, several runs were made in the same system using NO_2 at 1 ppm and 3-methyl heptane at 1 and 700 ppm. After 10 hours of irradiation, cracking of rubber was confirmed at the 1-ppm hydrocarbon level, with no cracking found at the 700-ppm concentration level.

Investigation of the photochemistry of the NO_2-3-methyl heptane system continued in our laboratory. A 2-lit Vycor photolysis flask was wrapped in aluminum foil except for an opening to admit the collimated radiation from a Hanovia Type A mercury arc that was filtered with a Pyrex filter to cut out radiations at wavelengths below 3000 A. The use of the reflective lining on the flask to form a multiple reflection system was necessary to achieve sufficient light intensity with this system. A relatively uniform radiation flux was thereby obtained. The radiation intensity, as determined with a photoelectric probe, was approximately the same as that of noon sunlight in the ultraviolet region but considerably less in the visible region.

At the conclusion of photolysis, the reaction mixture was passed through liquid-oxygen-cooled traps packed with glass beads and then through a train of three bubblers containing alkaline phenolphthalin reagent. Oxidant values were obtained by spectrophotometric measurement of the partially oxidized reagent mixture. Controlled experiments revealed that NO_2 was efficiently trapped in the freeze-out traps and did not contribute to oxidation of the reagent. Presumably, oxidants less volatile than NO_2 (peroxides, and so on) would also be trapped. The physical evidence therefore points strongly to ozone as the principal oxidant product of the photochemical reaction.

Table 1. Photolysis results with full mercury arc (Hanovia Type A).

Time (hr)	Concentrations (ppm)			
	3-methyl heptane	NO_2 initial	Ozone	NO_2 recovered
3	13.2	1.36	0.89	0.08
1	14.7	1.47	0.33	1.44
1	8.9	0.76	0.38	1.07
3	20.4	0.93	0.86	0.24
17	10.0	0.48	0.53	0.18
3	3.5	0.65	0.97	0.05
3	0.97	0.50	0.59	0.20
5	0.00	1.11	0.0	1.47
3	3.9	0.72	0.2*	0.51
3	2.3	0.72	0.44	
3	1.35	0.48	0.39	0.51
3	0.04	0.50	0.0	0.76
3	3.3	0.00	0.00	0.00

* Corning-7380 glass filter 2 mm thick cut out 3130 A radiation but passed 60 percent of 3660 A.

Typical results of irradiation of NO_2 and 3-methyl heptane in oxygen are given in Table 1. No ozone was obtained when either the NO_2 or the hydrocarbon was omitted. Recovery of NO_2 from the freeze-out traps was checked by analysis with the Saltzman reagent (*6*). A tendency toward high recovery by this method has not been completely resolved, but the results consistently show low recovery (or none) in photolyses in which an appreciable quantity of ozone was found.

These experiments support the finding of Haagen-Smit that traces of NO_2 and hydrocarbon in air undergo a photochemical reaction to produce ozone. Furthermore, NO_2 is consumed in the course of the reaction, indicating that NO_2 is more than a radiation absorber. Work is in progress to determine the stoichiometric relation between ozone formed and NO_2 consumed. A paper presented late last year by Hanst and coworkers (*7*) confirms the oxidant as ozone by infrared spectroscopy and also shows disappearance of NO_2 as the reaction proceeds.

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14 November 1955

Temperature Control in the Measurement of Particle Volumes by the Isopiestic Method

Crozier has recently reported (*1*) some observations on the relative volumes of small droplets (diameter about 10^{-3} cm) of sodium chloride solutions equilibrated in atmospheres of varying water vapor pressure. Rather large discrepancies were noted between observed volumes and those calculated from ICT values for the vapor pressures of NaCl solutions at the temperature employed (25°C), which the author was unable to explain. The particle sizes were in the range where the Thompson-Gibbs effect is slight, and this effect was, in any case, allowed for. We have been performing

experiments (*2*) similar to those reported by Crozier and have observed effects that can cause the discrepancies noted.

The isopiestic method (*3*) involves the equilibration, in an enclosed space, of solutions of nonvolatile solutes in the same solvent. At equilibrium, the activity of the solvent is the same in all the solutions. The use, at a fixed temperature, of a large quantity of a suitable saturated solution in contact with excess solute provides a fixed, known vapor pressure within the enclosed space. If droplets of a second solution are in equilibrium with this vapor, their composition is determined by their temperature and by the vapor pressure. Crozier's microscopic droplets of sodium chloride were deposited on Dri-Film or Teflon slides and exposed in a closed box to atmospheres of several different water vapor pressures. Observed drop diameters were converted to drop volumes, assuming hemispherical particles. The relationships between these volumes were considerably different from those predicted from ICT vapor pressure and density data (Fig. 1).

Crozier assumed that his droplets were at the same temperature as the air and the saturated solutions within his small observation box. In similar studies, however, we found that a significant temperature differential existed between the droplets and the air to which they were exposed. We passed air that was conditioned to various water contents and maintained at 25.0°C through an observation cell containing upper and lower windows. A microscope lamp, equipped with a water cell, illuminated the substage mirror of a microscope, upon whose stage the observation cell was placed. Droplets of NaCl solution (in the same size range as those of Crozier) were deposited upon a glass cover-slip about 10^{-2} cm thick, and the cover slip was inverted to form the upper window of the observation cell. An oil immersion lens was used to observe the particles through the glass, and a fine thermocouple was placed in the oil in contact with the glass surface.

The thermal resistance of the glass being relatively slight, the temperature of the particles could be taken as nearly equal to that of the thermocouple. Other sensitive thermocouples were employed to measure the air temperature and humidity. The microscope and all the apparatus were installed in a constant-temperature room at 25°C. Under these circumstances, it was observed that the cover-slip temperature started to rise as soon as the (water-cell equipped) microscope illuminator was turned on, and that it continued to rise until there was more than 0.5°C difference in temperature between glass and air.

In previous work, even larger variations in the cover-slip temperature had been noticed when the apparatus was located in a room where the temperature was not closely controlled. On warm days, the junction in the immersion oil indicated temperatures considerably higher than 25°C, despite the large volume (about 8000 cm^3) of 25.0°C air passing through the small cell (about 25 cm^3) each minute.

As a result, NaCl crystals on the cover-slip sometimes did not pick up moisture until the relative humidity of the 25.0°C air passing through the cell was raised to more than 80 percent, whereas 75.5 percent should initiate particle growth. It seemed reasonable to believe that heat was being conducted to the oil and the cover-slip by the microscope.

It is apparent that, when relatively large plane surfaces are used for the support of droplets, heat transfer from surface to droplet can introduce serious error. As a matter of fact, the resistance to heat transfer that is offered by the air near the particles is so great that the thermal resistances of the droplets themselves are of negligible effect. The particles are essentially at the same temperature as the surface that supports them, even though the nearby air may be warmer or cooler.

We have recalculated the equilibrium relative humidities that would have existed at the surfaces of Crozier's NaCl droplets, if his Teflon and Dri-Film surfaces (and his droplets) were, for example, 0.8°C warmer than the saturated solutions contained in his box. With water at 25.0°C, assuming equilibrium in water concentrations, the slide surface at 25.8°C would be exposed to a relative humidity of 95.4 percent instead of 100 percent. Similarly, saturated $(NH_4)H_2PO_4$ would yield a local relative humidity of 88.7 percent instead of 93.0 percent, and $(NH_4)_2SO_4$ would yield 77.4 percent instead of 81.1 percent. Employing these new relative humidity values, we have replotted a sample set of the droplet volumes recorded by Crozier, on Fig. 1. It will be observed that the revised plotting is in good agreement with the theoretical relationship between particle volume and relative humidity that is derived from ICT data. Similar treatment will yield similar results for the other droplets examined. The results obtained by Crozier could. therefore, be satisfactorily explained by the existence of a rather small temperature differential.

From Fig. 1, it is also apparent that the error that may be incurred by assuming, rather than determining, that isothermal conditions exist increases greatly as the relative humidity increases.

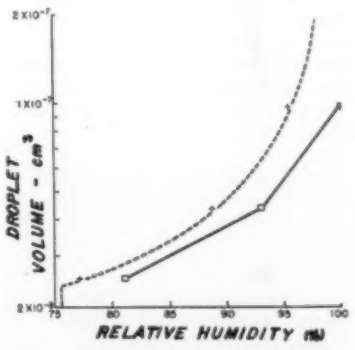

Fig. 1. Relationship of droplet volume to relative humidity. Solid line connects typical experimental points (□) obtained by Crozier (*1*). Broken lines are the calculated relationships based on vapor pressure and density of NaCl solutions; points marked (+) represent Crozier's data corrected as indicated in the text.

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14 November 1955

Occurrence of Three Red Blood Cell Antigens in Rabbit as the Result of Interaction of Two Genes

In the course of the study of blood groups in the rabbit (*1*), isoimmunization techniques have been used to prepare specific antiserums that detect the presence of seven rabbit red blood cell antigens (labelled *A*, *B*, *C*, *D*, *E*, *F*, and *H*) (*2*). The mode of inheritance has been studied, and it has been shown that these antigens are controlled by five loci (*3*). A new isoantibody has been prepared that appears to identify an antigen resulting from the interaction of a pair of previously identified allelic genes.

The locus with which we are concerned has three alleles (Hg^A, Hg^D, and Hg^F), each of which gives rise to a detectable antigen. Thus, all rabbits must have antigen *A*, *D*, or *F*, or a combination of any two of these antigens. A new isoimmune serum appeared to contain three specific antibodies. One was identified as anti-*D*, and another as anti-*H*. The third antibody, called anti-*I*, was isolated by the absorption of the whole serum by cells of type *D* and by cells of type *AFH*. The resulting typing serum,

Table 1. Mean scores of cells of known phenotype when tested against specific antiserums.

Phenotype	Mean score
Pooled anti-A serum	
A	29.5
AF	31.9
AD	14.8*
Anti-D serum	
D	48.0
DF	53.8
AD	27.3*

* $P < 0.01$.

when tested against a panel of rabbit cells containing all our previously identified antigens, reacted strongly with cells that had antigens *A* and *D* and did not react with cells that were homozygous for *A*, *D*, or *F* or with cells that were heterozygous for *AF* or *DF*.

Matings were made to include all combinations of blood groups controlled by this locus; antigen *I* consistently appeared only when, as a result of segregation, the genes for *A* and *D* occurred in the animal. In all, 223 animals in our colony were typed, and of these 63 were found to be type *ADI*. In no case did *I* appear when neither *A* nor *D* was present. In no case was antigen *I* missing when both *A* and *D* were present. As the result of our attempts to maintain lines of inbred rabbits, we had available at least three generations of animals showing segregation for the genes Hg^A and Hg^D. The complete pedigree, shown in Fig. 1, indicates the relationships that must exist for the appearance of *I*.

In studying the effect of genotypes on the reactivity of cells, we compared the relative titers of various typing serums as they reacted with cells with antigen combinations resulting from the *Hg* allelic series. Anti-*A* was titrated against cells of animals of phenotypes *A*, *AD*, and *AF*; anti-*D* was titrated against cells of animals of phenotypes, *D*, *AD*, and *DF*. The scoring method suggested by Race and Sanger (*4*) was used to measure the titer of the typing serum. In every case the score for the *AD* cells was significantly ($P < 0.01$) lower than that for the other antigenic types (Table 1).

This finding, also reported in part by Joysey (5), is consistent with the concept that the interaction of genes Hg^A and Hg^D results in the formation of three products that perhaps involve a common substrate somewhere in the process of action so that the amount of antigens *A* and *D* is diminished. No attempt will be made at this time to give a physiological explanation of the reaction beyond the statement that two genes have clearly given rise to three antigens. The following genetic hypotheses may be rejected as inconsistent with the data: recessivity, and linkage between the *Hg* series and a gene giving rise to antigen *I*. The interaction postulated for the existence of human *f* may be similar to our findings, but *f* is dependent on *c* and *e* being on the same chromosome. In our example, Hg^A and Hg^D cannot be on the same chromosome.

The rare occurrence in offspring of cellular antigens that do not occur in either parent has been reported by Irwin (*6*), Thompsen (*7*), Boyd and Alley (*8*), and more recently by Rendel, Sorensen, and Irwin (*9*) and Levine *et al.* (*10*).

Our findings described here are of interest in three areas. First, the appearance in the rabbit offspring of antigens that are not present in either parent is one of a few cases in mammals. The use of blood groups in paternity cases is based on the premise that a child cannot have an antigen that is not present in either parent. Although the findings in the rabbit cannot, of course, be extrapolated to human blood groups, it is possible that such a phenomenon as that reported here may occur in human beings.

The second area of interest is that of the gene-antigen relationship. Since we have shown that two genes can give rise to three detectable antigens, the one gene-one antigen relationship obviously does not hold true for all situations.

Third, there have been several theories proposed on the mechanism for selective value of heterozygotes. The findings reported here support the theory of Rendel (*11*) and Haldane (*12*), among others, that the heterosis effect may be due to the fact that the products of the interaction of two alleles may be more effective than the product of either homozygote.

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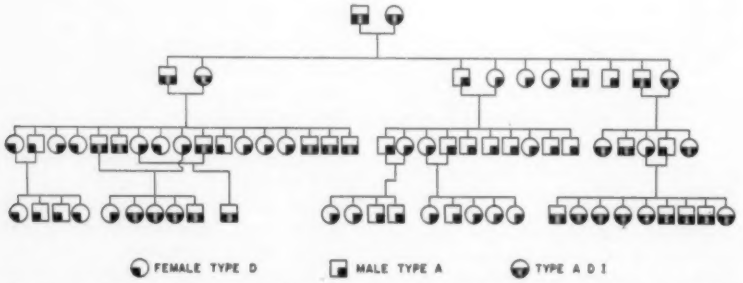

Fig. 1. Pedigree of a family of rabbits showing the inheritance of antigens *A*, *D*, and *I*.

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31 October 1955

Efficacy of Striatal Shocks in Avian Conditioned Behaviors

A cursory investigation has shown that electric stimulation of the striatum of the pigeon can serve as a conditioned stimulus in both classical and instrumental situations. In three pigeons, silver-wire electrodes spaced 1.5 mm apart and insulated except at the tips were implanted in one hemisphere of the forebrain and affixed firmly to the skull. Leads were brought through the skin to allow direct connection with a stimulator. Such preparations could be maintained indefinitely without danger of infection or other complications. Post-mortem gross examination, correlated with histologic study of other specimens, suggested that the electrode tips were placed in the neostriatum intermediale just below tractus fronto-occipitalis (*1*). When delivered to this region, a very brief 60-cy/sec pulse of about 2 v produced discrete and highly consistent turning of the head in the direction opposite to the side stimulated. If the voltage was very slightly reduced, there was no observable response. If the voltage was very slightly increased, the result was "startle" in two birds, and indiscriminate jerking and struggling in the third.

One pigeon was trained to flex its leg in response to striatal stimulation. The unconditioned stimulus, an electric shock to the skin on the thigh, evoked a clearly unilateral leg flexion. A 0.75-sec striatal

shock just sufficiently intense to evoke a headturning response was given immediately before the leg shock. Thirty reinforced trials per day were given, with two additional nonreinforced striatal test shocks. Anticipatory flexions began to appear on the fourth day of training and continued during the subsequent 5 days of training and testing. The flexion response failed to appear to a test shock given 2 months later, but reappeared on the second day of retraining. The electrodes were in the right forebrain, and the right thigh was shocked.

That cues arising out of head movement were not operative is suggested by the following observation. Conditioned flexion was not established in three pigeons given 200, 400, and 600 trials when a bright light, toward which the birds turned their heads, was substituted for the striatal shock. Whether the striatal shock evoked a sentient response, such as an aura, or a motor response, such as an adversive movement, cannot be specified. It is interesting to note that investigation of this area, under Nembutal, with a 5-micron glass microelectrode showed many tonically active units (which were diphasic and initially negative with respect to the indifferent electrode), but no units responsive to leg shock. It was necessary to penetrate below this area, probably to tractus thalamo-frontalis medialis of the forebrain bundle, to find fiber activity. In this region, a good primary response with a latency of about 14.5 msec was recordable following leg shock. A reflex discharge from leg movement subsequent to the leg shock was also found. The lesser amplitude and pure positivity of this response suggested that it was somewhat removed from the point of recording.

Two birds were trained to peck at one of two simultaneously presented visual figures when a striatal shock or external light was presented in order to obtain food reward. Twenty trials were given daily until a criterion of 16 consecutive correct responses was attained. One pigeon was required to peck a black triangle after striatal shock and horizontal black lines after bright light. This subject reached the criterion performance level in 113 trials and maintained a very high level of performance during the 160 trials of overtraining. The other bird, given the reverse task, attained the criterion in 86 trials. The light and shock were presented in random sequence, and the visual figures appeared randomly to the right or the left of each other in a discrimination apparatus that has been described in detail elsewhere (*2*).

Usually, a pigeon requires about eight training trials before it discriminates perfectly between the two figures used in the customary discrimination procedure. Thus, this far more complex task was mastered in only 10 times the number of trials. Acquisition of the two discriminatory-conditioned responses appeared at about the same rate, possibly signifying that the striatal stimulation was also operating on the sensory side. An auditory signal presented after learning did not evoke pecking; hence the mere lack of light or the presence of some stimulus other than light was probably not sufficient to produce the "striatal-conditioned response."

If purely motor effects resulted from the striatal stimulus, the instrumental discriminative response is in line with previous observations, but the classical leg conditioning is not (*3*). Ancillary experiments indicated that movement-produced cues were not operative in this situation. It therefore appears that the neostriatal stimulation gave rise to a sentient response that was more efficacious than the peripherally evoked sensory response in the nonreward situation, and was equally efficacious in the instrumental-discriminative situation.

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28 November 1955

Chinese Walls of New Cave, Carlsbad Caverns National Park

Speleothems—Moore's proposed term for cavern formations (*1*)—are as variable as the caverns and caves in which they form. Although I have seen many types of speleothems in Carlsbad Caverns National Park, New Mexico, there are none that challenge one's imagination more than the Chinese Walls (Figs. 1 and 2) of New Cave (once known as Slaughter Cave).

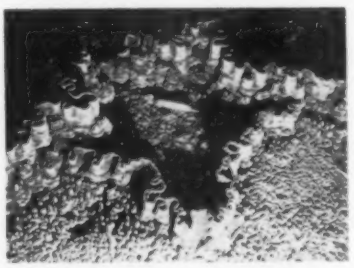

Fig. 1. View of several feet of the Chinese Wall. Two levels of terracing shown. Size is indicated by the pocketknife in the foreground between the walls.

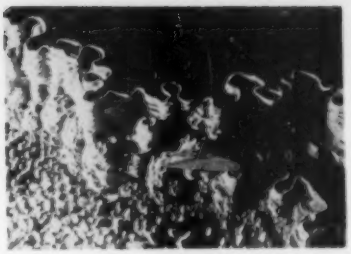

Fig. 2. Close-up view of a small section of the Chinese Wall. Gravel-size accretions are in the foreground. Scale is indicated by the pocketknife in the foreground.

Unlike most speleothems, these walls have no apparent pattern other than that of growing vertically. There are no shelves of minerals or water lines that might indicate water levels. The trace of the meandering tops of the walls curve or furl as often in one direction as in another. Some furlings are so well developed that they nearly form vertical tubes. Only one characteristic seems to have any consistency: the degree of furling apparently increases with the amount of vertical growth. Unlike retaining dams (*2*) and embaying walls of Carlsbad Caverns, the Chinese Walls do not overhang or obviously grow toward any particular direction. Tests made on small sections indicated that these walls are able to withstand more than 100 pounds of compressive pressure to each inch of trace. The furling course of the trace probably accounts for the strength that has preserved it from vandalism. When I last observed it in 1951, only a few small pieces had been broken from the wall.

To complicate their study still further, free, gravel-like accretions cover the flat floors between the walls. These accretions have a rough, granular surface (Figs. 1 and 2) and should not be considered to be cave pearls. Apparently they are in place, since no stream channels or gravels were noted.

Many speleologists would consider the meandering and furled walls to be just "rimstone." Although they apparently did "rim" pools of water at one time, they definitely differ from any of the rimstone I have seen in Carlsbad Caverns. The trace of that in the former is very irregular, whereas the traces of the latter are often gently arching for a distance of several feet. It is my opinion that the Chinese Walls of New Cave should be considered a special type of "furled retaining wall."

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25 November 1955

Some Potassium-Argon Ages for Western Canada

Recent deep exploratory drilling has provided core samples of the Pre-Cambrian basement rocks that underlie the plains of western Canada. A number of these samples (*1*) contain potassium-bearing minerals in sufficient quantity to permit age determinations to be made by the potassium-argon method. Table 1 gives the ages determined for 15 core samples from Alberta and Saskatchewan. The ages of two outcrop samples from the Marian River area of the Northwest Territories are also given.

The basis of selection of core samples was high potassium content and lack of evidence of hydrothermal alteration or weathering. All of the samples are of granitic composition. Samples 1268, 1290, 1291, and 1292 are alkali granites. Sample 1295 is an alkali rhyolite. The remaining samples are calc-alkali granites and adamellites. Potash feldspar supplies the greater part of the potassium content of the rocks. The mica content is generally less than 5 percent. In only three samples—1268, 1433, and 1434—does the mica content exceed 10 percent.

Potassium-argon ages are calculated from the formula

$$t = \frac{1}{(1+R)\lambda_\beta} \cdot \ln \left\{ 1 + \frac{1+R}{R} \cdot \frac{A^{40}}{K^{40}} \right\}$$

where, in the absence of loss of argon from the minerals, R is the branching ratio, defined as the rate of orbital electron capture divided by the rate of beta-particle emission. Two values of R have been reported from argon measurements on dated feldspars, $R = 0.089$ (*2*) and $R = 0.085 \pm 0.005$ (*3*). However, it has now been verified at several laboratories that micas give consistently higher potassium-argon ages than do feldspars from the same deposits, indicating the probable loss of argon from feldspars. If the loss from feldspars is nearly constant, the afore-mentioned values for R can be used in the equation to determine the approximate ages of feldspars. This was the procedure adopted for this preliminary report.

For λ_β, the transformation constant for beta emission, a value of 0.503×10^{-9} yr^{-1} has been obtained from 11 of the most recent counting experiments (*4*).

K^{40} is the mass of potassium-40 per gram of sample. It was calculated from the potassium analyses by assuming Nier's value of 0.0119 percent for the isotopic abundance of potassium-40 (*5*). Total potassium was determined by gravimetric analysis as the chloroplatinate, following decomposition of the sample by the J. Lawrence Smith method. Potassium was corrected for rubidium content, which was determined by flame spectrophotometer.

A^{40} is the mass of radiogenic argon-40 present per gram of sample, as determined by a procedure that has already been described (*4*). At least two determinations were made on all samples except 1295, 1436, and 1437. All argon samples were analyzed by mass spectrometer and corrected for contamination by atmospheric argon. This correction was generally less than 10 percent. The error placed on the potassium-argon ages has been calculated by using an estimated mean probable error of 10 percent in the A^{40}/K^{40} ratio. The agreement between individual analyses was generally more accurate than this.

Table 1. Potassium-argon ages for some core samples from western Canada.

Toronto No.	Location (lat. N. and long. W.)	Sample depth (ft)	A^{40}* wt. ($\% \times 10^{-5}$)	K_2O wt. (%)	A^{40}/K^{40}	Age (10^6 yr)
1290	Imperial Bistcho Lake (59°52′, 118°19′)	6,120	4.58 ± 0.02	5.12	0.089	1350 ± 90
1291	Imperial Lutose Creek (59°20′, 117°20′)	4,525	3.97 ± 0.12	5.11	0.077	1210 ± 80
1434	Imperial Loon Lake (56°28′, 115°20′)	4,980	5.62 ± 0.80	4.33	0.129	1730 ± 120
1293	Shell B. A. Whitelaw (56°06′, 118°12′)	7,492	4.90 ± 0.40	4.60	0.106	1520 ± 100
1292	Imperial Tangent (55°56′, 117°36′)	7,596	8.23 ± 0.70	8.17	0.100	1460 ± 100
1266	Shell Reno (55°58′, 116°31′)	6,768	4.73 ± 0.03	5.96	0.079	1220 ± 90
1294	Imperial Clairmont (55°16′, 118°37′)	11,700	4.77 ± 0.07	5.15	0.092	1380 ± 90
1270	Bear Biltmore (56°32′, 112°35′)	2,855	8.12 ± 0.10	6.13	0.134	1770 ± 120
1289	Bear Biltmore (56°32′, 112°35′)	2,857	7.48 ± 0.30	6.45	0.115	1600 ± 110
1267	Bear Vampire (56°34′, 111°50′)	2,302	6.20 ± 0.05	7.09	0.087	1310 ± 90
1432	Alberta Govt. Salt Well No. 2 (56°40′, 111°15′)	789	5.10 ± 0.30	6.08	0.083	1270 ± 80
1433	Imperial Grosmont (54°49′, 113°29′)	6,405	1.88 ± 0.40	6.09	0.030	570 ± 50†
1268	Imperial Ardrossan (53°33′, 113°03′)	7,800	4.70 ± 0.02	6.19	0.075	1180 ± 80
1269	Imperial Leduc No. 530 (53°19′, 113°45′)	8,985	3.38 ± 0.12	3.73	0.088	1330 ± 90
1295	Tide Water Crown Johnson Lake (50°11′, 106°14′)	7,785	5.15	5.03	0.101	1470 ± 100
1436	Marian River Area, NWT TXG 51 Claim (63°24′, 116°40′)		5.77	4.85	0.118	1630 ± 110
1437	Marian River Area, NWT FG 1 Claim (63°27′, 116°33′)		2.97	5.07	0.078	1220 ± 80

* Uncertainty shown is standard deviation of individual measurements.
† Anomalously low result believed to be in error.

The determination of potassium-argon ages of core samples from Alberta was undertaken in order to extend Pre-Cambrian geochronology to a previously inaccessible area. In view of the subsequent discovery of the leakage of argon from potash feldspar, the reported ages must be regarded as tentative. Their value is that they represent the minimum ages of the rocks concerned. Also, the agreement of a number of the ages from western Alberta may indicate the existence there of a Pre-Cambrian terrain somewhat younger than the previously dated Churchill province of northern Saskatchewan (*6*). Further age determinations on biotite separated from these samples will be required to confirm the age of the Pre-Cambrian of this area.

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References and Notes

1. Samples for this study were supplied by Imperial Oil Limited, Pacific Petroleums Limited, Shell Oil Company, and Tide Water Associated Oil Company. The research was aided by fellowships awarded by Standard Oil Company to

H. A. Shillibeer and by Imperial Oil Limited to R. A. Burwash. The assistance of the members of the Geophysical Laboratory, University of Toronto, and the Rock Analysis Laboratory, University of Minnesota, is gratefully acknowledged.

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28 November 1955

"Whirling Behavior" in Dogs as Related to Early Experience

In the course of 3 years of experimentation on the relationship of early experience in dogs (Scottish terriers) to their later behavior, there has appeared an interesting phenomenon that is worth reporting separately (*1*). This is the occurrence of "whirling fits" in a number of dogs that were restricted during early life.

Restriction is imposed by rearing the experimental animals from 1 to 8 or 10 months of age in isolation cages (one dog per cage) that are so constructed that the dog inside each can never see any more than the floor of the cage above or the ceiling of the room. By means of a small side compartment adjoining the living space and separated from it by a sliding panel, feeding and cleaning can be accomplished without exposing the restricted animal to the outside environment. After the period of restriction is over, the experimental "Scotties" are compared by means of psychological tests with their littermates which have been reared normally as pets in homes.

Many striking differences have appeared between the normal and the restricted dogs in all phases of behavior, including intelligence, activity, emotionality, and social behavior. These are reported in full elsewhere (*2*). More bizarre than any of these effects of early restriction are the afore-mentioned whirling fits. These have appeared in eight out of eleven severely restricted animals. The three exceptions, while highly active and excitable, have not, to our knowledge, shown the extreme behavior discussed here.

Whirling can be described as follows: very rapid, jerky running in a tight circle; shrill, agonized yelping; barking and snarling; and tail snapping and tail biting. The syndrome may last from 1 to 10 minutes. It is usually heralded by certain characteristic signs. The dog suddenly becomes motionless, cocking its head up and back, as if looking at its own tail. It begins to growl viciously, and its eyes take on a glazed expression. These signs may continue for a minute or two, increasing in intensity until the full-blown fit occurs. To all appearances, whirling does not seem to be under voluntary control but to be "driven." The dog does not seem to be able to control its behavior and cannot usually be distracted even by fairly intense stimuli.

Whatever its nature and causes, whirling is a peculiar and striking form of behavior that is worth further investigation. Several points concerning it should be noted. In the first place, it seems to vary in degree, with respect to both intensity and duration.

Second, although many of the fits appear to occur spontaneously (in that the immediate causes are not known), they usually seem to be set off by some change in the stimulus-environment. This change may be anything from the mere introduction of a food dish into the cage to electric shock or restraint in a harness for a period of time.

Third, all the dogs showing whirling fits shared, to some degree, a common ancestry. All were descendants of three Scotties purchased from Hamilton Station, Bar Harbor, Maine, and bred, within themselves and to outside dogs, for several generations. However, the three animals not showing this behavior were also related to this strain. Consequently, it is difficult to make any obvious inferences concerning the possible genetic origin of the trait.

Fourth, all dogs showing whirling have had a background of severe restriction in early life. None of their normal littermates have shown such behavior. At the same time, since the three exceptions have also undergone restriction, this kind of early experience is not a sufficient condition for the appearance of the symptoms, although it may be a necessary one.

In view of the foregoing points, it is difficult to know what ultimate factors predisposed some animals to whirling fits. Diet is a possible explanation, although it could not be the only cause, since all the animals in the laboratory were fed the same amount and type of ration made up according to the specifications of several experts in dog care. All dogs received, during a typical week, meat (liver, Pard, hamburger), dog biscuits, Purina Dog Chow, vegetables, cod-liver oil, and milk while they were puppies. The restricted animals showed appetites as good or better than normals. At the same time, we cannot rule out the possibility that this diet might have been inadequate for dogs raised in severe restriction, even though it appeared to be adequate for dogs living in normal environments.

The possibility that whirling was caused by a specific irritation in the tail —thus causing the circling and tail snapping—is unlikely. It does not seem reasonable to suppose that such extreme behavior could be set off so easily and set off only under special conditions involving a change in the sensory environment. When tail injuries did occur, they appeared definitely to be the result rather than the cause of whirling. Consequently, we are inclined to feel that the behavior is central and not peripheral in origin.

Finally, it must be mentioned that the dogs were constantly checked for signs of worms and distemper by examination of their feces and by noting any decline in appetite. There was no evidence of ill health among any of the experimental dogs during their period of restriction. After removal from restriction, they were examined more carefully by a veterinarian, with negative results.

Accordingly, there are considerable grounds for supposing that whirling is dependent, at least partly, on the conditions of restriction imposed during early life. Whether or not it can properly be described as epileptiform is a moot point. None of the parasympathetic components of true seizures were ever observed in the dogs. On the other hand, the gross features of its expression would suggest that it is essentially a related phenomenon.

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1 November 1955

Action of Some Centrally Acting Drugs on Ion Transport in Red Cells

Stimulation of excitable tissue is known to be followed by a decrease in membrane potential, which is accompanied by an increased permeability of the tissue to sodium and potassium (*1*). Thus, the cell, on stimulation, loses potassium and gains sodium. During recovery, sodium is removed from the cell and potassium is replaced. The recovery process depends on the active transport of one or both cations, since the movement is against the concentration gradient.

When human blood is refrigerated, the

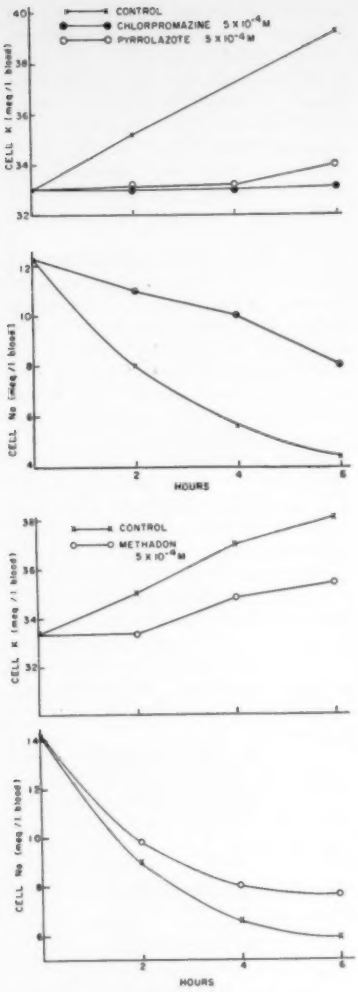

Fig. 1. Erythrocyte sodium and potassium plotted against time.

erythrocytes lose potassium and gain sodium. On warming to 37°C in the presence of the appropriate substrate, potassium is replaced in, and sodium removed from, the cell (*2*). There is no proof at present that the mechanism for active transport of cations is the same in all tissues, but it is likely that the fundamental process is, at least, similar.

The action of certain drugs that affect the central nervous system has been tested on the transport of sodium from, and potassium into, erythrocytes of blood that had been refrigerated for several days and then incubated at 37°C.

Freshly drawn human blood was defibrinated by shaking it with glass beads under sterile conditions and was stored in the refrigerator at about 5°C for 3 to 5 days. During this time, the erythrocytes lost potassium and gained sodium. On removal of the blood from the refrigerator, glucose (1 mg/ml blood) was added to it; sodium chloride solution (0.9 percent) was added to the control suspension (0.1 ml/ml blood); and the drug, which was dissolved in sodium chloride solution (0.9 percent), was added to the experimental suspensions. The blood was incubated at 37°C, and, at intervals of about 2 hours, 1-ml samples were removed and centrifuged. The plasma was removed from each sample, and the cells were washed with sucrose solution (9.8 percent) and hemolyzed by the addition of distilled water. The protein was precipitated by adding trichloroacetic acid to the hemolyzate to give a final concentration of 5 percent. The filtrate was used for the determination of sodium and potassium, using the Beckman DU spectrophotometer with flame attachment.

The drugs that were tested on the extrusion of sodium from, and uptake of potassium by, red cells were morphine sulfate ($10^{-3}M$), pentobarbital sodium ($2 \times 10^{-3}M$), methadone (*3*) (2.5 and $5 \times 10^{-4}M$), cocaine ($3 \times 10^{-4}M$), Pyribenzamine (*4*) ($3 \times 10^{-4}M$), chlorpromazine (*5*) (2.5 and $5 \times 10^{-4}M$), and Pyrrolazote (*6*) ($5 \times 10^{-4}M$). Three of these drugs—namely, methadone, chlorpromazine, and Pyrrolazote—inhibited both sodium and potassium transport. The results of a typical experiment are shown graphically in Fig. 1. This effect is similar to that described by Schatzmann (*7*) and by Glynn (*8*) for certain cardiac glycosides. The other drugs had no effect under our experimental conditions.

The concentrations of methadone that were used are sufficient to inhibit glycolysis and carbohydrate oxidation by brain tissue (*9*). However, the concentrations of the phenothiazine drugs that were used in these experiments had no effect on either glycolysis or oxidation of glucose by brain tissue. Thus, inhibition of transport cannot be correlated with inhibition of glycolysis in the case of the phenothiazine drugs.

The concentrations of phenothiazine drugs that were used in these experiments to inhibit ion transport are several times greater than those required to inhibit hemolysis by lysolecithin (*10*).

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4. Pyribenzamine hydrochloride, 2-[benzyl(2-dimethylaminoethyl)amino]-pyridine hydrochloride.
5. Chlorpromazine, 10-(α-dimethylaminopropyl)-2-chlorphenothiazine hydrochloride.
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25 November 1955

Enzymatic Detoxification Mechanism for Viadril

The structural similarity of the steroid anesthetic, Viadril (*1*) (pregnan-21-ol-3,-20-dione 21-hemisuccinate) (*2*), to substrates of several enzymes currently under investigation (*3–5*) has suggested that related reactions may be involved in its detoxification. Thus, Viadral might be reduced at the 3-position (reaction 1), and then be conjugated as the glucuronide (*6*). Alternatively, the following sequence of reactions may occur: esterase action on Viadril to produce succinate and pregnan-21-ol-3,20-dione (reaction 2), reduction of the steroid moiety catalyzed by 3α-hydroxysteroid dehydrogenase (reaction 3), and conjugation. These possibilities have been investigated, utilizing enzyme systems (*7*) partially purified from rat liver. The reactions examined were

$$\text{Viadril} + \text{DPNH} + \text{H}^+ \rightleftharpoons \text{pregnane-3}\alpha,\text{21-diol-20-one 21-hemisuccinate} + \text{DPN}^+ \quad (1)$$

$$\text{Viadril} + \text{H}_2\text{O} \rightarrow \text{Pregnan-21-ol-3,20-dione} + \text{succinate} \quad (2)$$

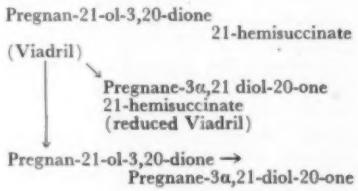
$$\text{Pregnan-21-ol-3,20-dione} + \text{DPNH (TPNH)} + \text{H}^+ \rightarrow \text{pregnane-3}\alpha,\text{21-diol-20-one} + \text{DPN}^+\text{(TPN}^+\text{)} \quad (3)$$

Reaction 1 was reversibly catalyzed by an ammonium sulfate fraction of rat liver that, when it was added to Viadral and DPNH, caused a rapid oxidation of the reduced pyridine nucleotide as measured in the spectrophotometer at 340 mμ. TPNH did not function in this reaction. When 3α-reduced Viadril (pregnane-3α, 21-diol-20-one 21-hemisuccinate) was incubated with the enzyme preparation and DPN^+, a prompt reduction of the pyridine nucleotide was observed. With 3β-reduced Viadril as substrate, DPN^+ was not reduced. It is of interest to note that reaction 1 was also catalyzed by αBAD (*3*) that was obtained from an organism isolated by enrichment culture. In the presence of DPNH, this enzyme reversibly reduces 3-ketosteroids with a terminal carboxyl group. Viadril was reduced to 3α-reduced Viadril by the enzyme at 40 percent of the rate of the reduction of ketocholanic acid.

Extracts of rat-liver acetone powder contained an esterase activity that catalyzed the hydrolysis of Viadril to succinate and pregnan-21-ol-3,20-dione (reaction 2). The enzyme activity was followed by measuring the unhydrolyzed ester that remained at the end of the incubation period, using the hydroxamic acid method of Baggett *et al.* (*8*). The steroidal hydrolysis product served as a substrate for reaction 3—that is, reversible reduction by reduced pyridine nucleotide in the presence of 3α-hydroxysteroid dehydrogenase from rat liver (*4*).

All the products of the reactions described were identified chromatographically, using modifications of the solvent systems of Bush (*9*). Calculation of the rates of the individual reactions, based on the assay conditions used here, yield the following values in micromoles of product formed per hour per gram of rat liver: reduced Viadril, 8; pregnan-21-ol-3,20-dione 21-hemisuccinate, 23; pregnane-3α, 21-diol-20-one, 15.

These findings are consistent with the following scheme for the detoxification of Viadril and predict the formation of conjugated forms of pregnane-3α, 21-diol-20-one 21-hemisuccinate and pregnane-3α, 21-diol-20-one as excretory end-products.



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References and Notes

1. Viadril is a trade name of the sodium salt of pregnan-21-ol-3,20-dione 21-hemisuccinate. Reduced Viadril refers to pregnane-3α,21-diol-20-one 21-hemisuccinate. Generous amounts of these compounds, as well as other steroids used here, were made available to us by the interested cooperation of G. D. Laubach and S. K. Figdor of Chas. Pfizer and Company.
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8 December 1955

Simple Procedure for Identification and Rapid Counting of Mast Cells in Tissue Sections

Early in an investigation of the distribution and numbers of mast cells in histologic sections of certain mammalian tissues and organs, it became evident that the microtechnical procedures in current use were not satisfactory. A review of 68 recent papers dealing with the occurrence of mast cells in tissue sections and spreads revealed that in only 7 instances were cell counts made that were susceptible to statistical analysis. Subjective impressions were frequently reported in lieu of numerical data, a fact deplored by Devitt, Pirozynski, and Samuels (*1*), who summarized the matter as follows: "Although numerical counting of tissue mast cells is difficult, and not an ideal method of investigating their response to various stimuli, their capricious distribution renders simple estimation of numbers by impression alone worthless."

There are two principal defects in the methods currently employed for the histologic demonstration of mast cells. In a surprisingly large proportion of the studies reviewed (38 percent), aqueous fixatives such as 10-percent formalin, Bouin's fluid, and Helly's fluid were used. These fixatives are notoriously unreliable for the preservation of mast cell granules, which are water-soluble in most species (*2*). Of even greater consequence was the widespread use of unbuffered aqueous solutions of basic thiazin dyes, most commonly toluidine blue. These dye solutions stain not only the mast cells but also the surrounding tissues, often to a very considerable extent (Fig. 1). As a result, in many instances the mast cells can be identified only with a high-power objective lens. Rapid and accurate counting is rendered difficult by the lack of differentiation, and it is especially troublesome in strongly basophilic organs such as the pancreas and liver.

To eliminate these difficulties, the following histologic procedure (*3*) was developed on the basis of theoretical considerations and practical experience.

1) Thin slices of fresh tissue (3 to 5 mm thick) are fixed in the following solution for 18 to 24 hours: formalin, 10 ml; 95-percent alcohol, 90 ml; and calcium acetate, 1 g. Specimens may be left in the fixative for at least 1 week without apparent harm.

2) After fixation, the tissues are washed in two changes of 95-percent alcohol (1 hour each). Paraffin sections (8 to 12μ thick) are subsequently prepared in the routine manner.

3) The mounted sections are deparaffinized, run through absolute to 95-percent alcohol, and then are stained in the following solution for 1 hour at room temperature: toluidine blue, 0.25 g; 70-percent alcohol, 100 ml; concentrated HCl, 0.5 ml. The dye solution should be filtered before using.

4) After the tissue sections are stained, rinse briefly in 95-percent alcohol containing 0.5-percent HCl to remove the excess dye (that is, until the sections are grossly colorless). Counterstain lightly by dipping in 0.01-percent eosin in 95-percent alcohol. Clear and mount in a resinous medium in the usual manner.

The results of this procedure are that mast cells and cartilage matrix are colored deep blue against a pale pink background (Fig. 2). The mast cells can readily be seen with the 10× objective lens. Satisfactory results have been obtained with sections of tongue, lung, liver, duodenum, spleen, and pancreas from the mouse, rat, bat, dog, and monkey.

The staining procedure presented here is based on the nonspecific binding of toluidine blue, a basic dye, with the acidic components in paraffin sections of tissues

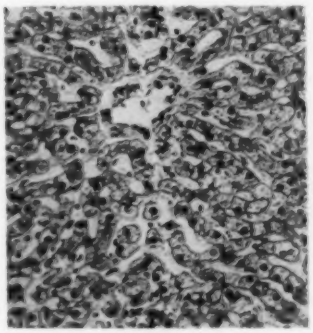

Fig. 1. Low-power photomicrograph of a section of dog liver stained with 0.25-percent aqueous toluidine blue. Note that the mast cells are obscured by the concurrent staining of the nuclei and of the cytoplasmic granules in the hepatic parenchymal cells.

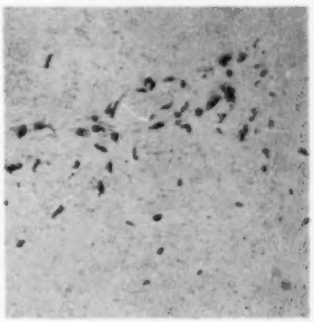

Fig. 2. Photomicrograph of a section parallel to that shown in Fig. 1, but stained by the procedure described in this report. Note that the mast cells stand out in sharp contrast to the lightly stained background.

that have been fixed in alcoholic formalin. Hence staining is not limited to the cytoplasmic granules of the mast cells. Because of the low *p*H of the dye solution, however, the dye binds with only the most strongly acidic tissue components, principally the sulfonated mucopolysaccharides. The only material in the tissues we have examined other than the mast cell granules, which is deeply stained, is cartilage matrix. In some organs that have a very high content of cytoplasmic ribonucleic acid or that have numerous dense nuclei, weak staining with the toludine blue may occur. Because there is little likelihood of confusion, the method can be considered, for practical purposes, to be highly selective for mast cells. It should also be noted that an acid dye is used as a counterstain only as a matter of convenience to facilitate the identification of the various tissues and organs on the slides.

The staining schedule given was deliberately designed to overstain the mast cells in order to obtain the greatest contrast with the surrounding tissues, and thus to make counting easier. If desired, greater cytologic detail can be obtained simply by shortening the period of staining in step 3. In order to make cell counts rapidly, the low-power objective lens may be used. To prevent confusion and in the interests of accuracy, however, scrupulous cleanliness must be observed during the preparation of the slides, especially in preventing the accumulation of dust particles on newly mounted sections during drying of the slides.

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22 November 1955

Role of Teachers in Scholarship Programs

As a local committee, concerned with improving science teaching in the secondary schools as one means of alleviating the present critical shortage of scientists and engineers, we feel that one aspect of our findings should be brought to the attention of *Science* readers. A complaint frequently voiced by high-school science teachers concerns the burden of noninstructional duties they are expected to bear. In addition to the records and forms required by various local, state, and federal agencies, these teachers receive a multitude of questionnaires, data sheets, and various other types of requests for information from many public and private organizations. It seems unfortunate, to say the least, that many of the requests come from well-intentioned groups that are working toward improvement of our educational system.

The citation of a single example will, perhaps, serve to emphasize our point. The National Merit Scholarship Corporation, financed by grants from foundations and industry, recently initiated the largest nongovernmental scholarship program in the history of American education. In this program, about 60,000 seniors, selected from 10,000 high schools, were given a 3-hour competitive examination, after which 4000 students were selected as semifinalists and given the scholastic aptitude test of the College Entrance Examination Board. The 2000 scoring highest in the latter test will become finalists, and from this group approximately 400 will be awarded scholarships ranging from $100 to $2000 based on need. If the average cost of a 4-year scholarship including a "cost of education" grant to the college is $6000 [*Science* **122**, 508 (1955)], then the annual total value of the 400 scholarships would be $600,000. Such a contribution is truly impressive and, at first glance, seems richly rewarding for all concerned. Superior students receive recognition and financial aid, colleges fortunate enough to be selected by these superior students likewise receive recognition as well as financial assistance, while the donors receive favorable publicity not only in connection with the national interest aroused by the program but also through donor-identity which is maintained with all scholarships.

One group, however, seems to have been completely overlooked. The high-school principals and teachers who were "invited" to participate in the program undoubtedly should receive recognition for stimulating and training the superior students who are selected for scholarships. Even if this is denied on the argument that the teachers are merely carrying out their regular duties, they should, at least, receive credit for the role they play in the scholarship program. On the basis of experience in local high schools, we have attempted to calculate the number of man-hours that principals and teachers must contribute in order to participate effectively. We estimate that completion of entry forms, conferences, and record checking to select the most promising students and administration of the first screening examination required 6 hours for each of the 60,000 examinees, or a total of 360,000 man-hours. The time required to compile and submit the information required for the 4000 semifinalists and 2000 finalists is difficult to estimate but would probably bring the total close to a half-million man-hours. Assuming that the teachers' time is worth at least $1 per hour, their contribution would be nearly equal to the total value of the scholarships. Even if these estimates, which are admittedly rough, were reduced by half, the teachers' contribution would still be tremendous.

We wish to make it clear that this statement is not intended as a specific criticism of the National Merit Scholarship Program. All of the high-school principals and teachers contacted felt that the program was well worth the time required for participation. Several pointed out that less valuable programs of various types made more excessive demands on their time. We hope that the example cited may encourage administrators of such programs to examine their procedures with the view of reducing to a minimum the demands placed on secondary-school personnel. In the case cited, we should also like to suggest that some concrete form of recognition be awarded to those high schools that have scholarship winners. This might be done by awards to the teacher or teachers that the winners designate as most responsible for their success, or, if such a plan is not feasible, an unrestricted award to the school for the purpose of improving teaching might be made. We believe that such awards would serve to draw public attention to the important contributions made by the secondary-school teachers.

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Infectivity of Tularemia Applied to Intact Skin and Ingested in Drinking Water

In his book on tularemia, Simpson described in the following words Francis' demonstration of the penetration by *Bacterium tularense* (*Pasteurella tularensis*) of the unbroken skin: "Francis dropped onto the unbroken skin of normal guinea pigs, suspensions of splenic tissue of guinea pigs recently dead of tularemia; the guinea pigs were dead in five days; at autopsy they showed the

characteristic spotted spleen and liver and the organism was recovered. . . ." (*1*). Although many investigators (*2*) have studied the infectivity of *B. tularense* and although Francis and others (*3*) have repeatedly called attention to infection by penetration, little is known quantitatively about this phenomenon. As a result, the importance of infection by penetration in the spread of tularemia has not been evaluated. Some investigators who are not familiar with *B. tularense* even question the fact of penetration. The set of data presented here is an attempt to determine quantitatively the infectivity of *B. tularense* through the unbroken skin in the albino laboratory mouse. Comparison is made to infectivity through the mucosa of the gastrointestinal tract.

For these experiments, pools of *B. tularense* suspensions were made with bacteria (*Aa strain*) (*4*) grown on blood-cystine-glucose-agar (BCGA) in petri dishes at 37°C for 3 days. The growth on each dish was suspended in 5 ml of sterile physiologic sodium chloride solution and pooled. Tenfold dilutions of these suspensions were made with tap water for testing infection by the cutaneous and oral routes. For intracutaneous infection, dilutions were made with sterile physiologic saline.

Infection by penetration was effected by rubbing 0.01 ml of *B. tularense* suspension through the fur on the abdomen with the smooth end of a glass rod. This operation was accomplished by manipulating a 4.0-mm, 10-g glass rod through a loose sleeve made of 6-mm ID tubing. The sleeve was rotated at the rate of 2 rev/sec for 15 sec, so that the rod spread the bacterial suspension over an area of from 12 to 15 mm in diameter.

In experiment B two types of oral infection were tested. In one series, mice were infected with contaminated drinking water. A bottle containing 55 ml of bacterial suspension was provided for each cage of 11 mice from which water had been withheld for the previous 18 hours. The mice in each cage consumed all of the contaminated water in 24 hours and then were given fresh bottles containing clean tap water. Another series of mice were infected by intubation; 0.2 ml of suspension was introduced into each animal's stomach through a blunt hypodermic needle sheathed with plastic tubing. For intracutaneous inoculation, 0.05 ml of suspension was injected into the right dorsal thigh of the rodent.

The mortality rate by the various routes of infection, observed in experiments A and B, are shown in Table 1. The number of viable *B. tularense* administered was calculated from BCGA plate counts. In experiment A, each intracutaneous inoculation dose of 10^0 dilution represented 2.4 organisms; and in experiment B, 0.7 organisms. The LD_{50}'s were 0.96 and 0.30, respectively. Since the 95-percent confidence limits of these LD_{50}'s overlapped one another over a wide range (Table 2), the average value of these LD_{50}'s was used as a baseline for comparing results from both experiments. Thus the average lethal infective dose of *B. tularense*, by penetration through unbroken skin under 10 g of pressure, was found to be 2 to 5 times greater than *per os* and more than 10^7 times that by intracutaneous inoculation.

These values are rough estimates, because many factors that influenced penetration have not yet been analyzed. For example, it is possible that the skins of active, mature mice have microscopic breaks caused by scratches, and so forth. Penetration would then depend on the number and extent of the breaks in the skin. Baby mice have smooth and intact skins; their skins are different from the mature mice in being tender and very thin. Also, baby mice instinctively tunnel under the mother to suck and often rub against one another during the period immediately after the application of the bacterial suspension. Thus the number of bacteria that the mice may have sucked or rubbed into membranes more susceptible than the skin, was not determined.

Another unknown factor may be the frequent grooming reactions of older mice. Judging by the size of the dose for fatal infection through the mouth, the effect of licking the fur on the infection rate through the skin is likely to be a negligible quantity and may be disregarded. Studies are in progress to ascertain some of the more pertinent factors of skin infection with greater accuracy.

Table 1. Mouse mortality ratios of the different dosages of *B. tularense* administered orally, intracutaneously, and applied to the skin surface.

Method	Number of *B. tularense* administered									
	10^{-2}	10^{-1}	10^0	10^1	10^2	10^3	10^4	10^5	10^6	10^8
	Number died/number used									
Experiment A										
Intracutaneous	0/11	1/11	8/11	10/11	11/11	11/11				
Applied to the skin: 1 wk old			0/ 7		0/ 7	0/ 7		2/ 7		5/ 7
Applied to the skin: 1 mo old			0/20		0/20	0/20		1/20		15/20
Applied to the skin: 6 mo old			0/10		0/10	0/10		0/10		5/10
Experiment B										
Intracutaneous	0/21	3/21	6/11	21/21						
Drinking water							0/22	1/22	1/11	16/22	22/22
Intubation								0/11	11/21	7/11	21/21
Applied to skin							0/21	0/21	0/21	12/21	

Table 2. LD_{50} doses of tularemia for oral and percutaneous experimental infection in mice.

Method and route of the infection	Expt.	LD_{50} dose	
		Calculated	95-percent fiduciary limits
Intracutaneous inoculation	A	0.96	0.28–3.26
Intracutaneous inoculation	B	0.30	0.14–0.87
Oral, intubation	B	10^8	$(0.13–7.9) \times 10^8$
Oral, drinking water	B	10^7	$(0.36–2.8) \times 10^7$
Through skin of 1 wk old	A	2×10^7	
Through skin of 1 mo old	A	2×10^7	
Through skin of 2 mo old	B	5×10^6	
Through skin of 6 mo old	A	4×10^7	

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References and Notes

1. W. M. Simpson, *Tularemia: History, Pathology, Diagnosis and Treatment* (Hoeber, New York, 1929), p. 22.
2. G. W. McCoy and C. W. Chapin, *J. Infectious Diseases* 10, 61 (1912); C. M. Downs *et al.*, *J. Immunol.* 56, 217 (1947); S. F. Quan, *Am. J. Hyg.* 59, 282 (1954); J. F. Bell, C. A. Owen, C. L. Larson, *J. Infectious Diseases* 97, 162 (1955).
3. E. Francis, *Medicine* 7, 411 (1928); V. E. Simpson, *Ann. Internal Med.* 2, 1092 (1929); F. Meerseman, *Rev. hyg. et méd. prévent.* 57, 591 (1935); E. Francis, *Public Health Repts. (U.S.)* 52, 103 (1937); L. Foshay, *Medicine* 19, 1 (1943); I. J. Tartakow, *N.Y. State J. Med.* 46, 1329 (1946).
4. The *Aa* strain was isolated from lone star tick from Arkansas by C. E. Hopla and C. M. Downs [*J. Kansas Entomol. Soc.* 26, 72 (1953)]. We are grateful to Cora M. Downs for supplying us with this culture.

30 November 1955

Book Reviews

Comprehensive Inorganic Chemistry. vol. 4. M. Cannon Sneed and Robert C. Brasted, Eds. Zinc, cadmium, and mercury, by Howard M. Cyr and the eds. Scandium, yttrium, and the lanthanides series, by Thomas D. O'Brien and the eds. Van Nostrand, New York, 1955. xii + 193 pp. Illus. $5.

The fourth member of this projected 11-volume reference work on the chemical elements and their inorganic compounds retains the simplicity of style and clarity of presentation that were characteristic of its predecessors. Although the series title suggests an encyclopedic work à la Mellor, the editors state that their aim is extensiveness in fields covered rather than fullness of treatment.

This volume presents a balanced but clearly limited survey of its subject matter. Part 1 ("Zinc, cadmium, and mercury") devotes more attention than usual to the industrial aspects of the inorganic chemistry of the IIb elements—as is consistent with the aims of a reference work written in part for the chemist in industry.

Chapters on the individual elements are preceded by an introductory section, containing an extensive table of physical properties of the metals, as well as an up-to-date table of isotopes. Each chapter contains a list of compounds in alphabetical order, with a description of properties, methods of preparation, and uses.

One rather puzzling feature of these chapters is the apparently random inclusion of crystallographic data, which in some cases is incomplete or erroneous, and in other cases redundant.

The introductory section of Part II ("Scandium, yttrium, and the lanthanide series") contains an extensive table of isotopes as well as a list of physical properties of the elements. The melting and boiling point data probably should be regarded with a good deal of skepticism, for most are at variance with recent observations.

Individual chapters on scandium, yttrium, and the lanthanide series are excellent within the limited range of subject matter considered. Some chemists probably will be disappointed that there is no detailed discussion of the magnetic or spectroscopic properties of the lanthanides, although recent work in these fields has been rather extensive.

Many chemists, however, will welcome these brief, authoritative and modestly priced volumes, in which the basic facts of inorganic chemistry are clearly and compactly assembled, leaving esoteric and doubtful material to references.

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Primates: Comparative Anatomy and Taxonomy. vol. 2, *Haplorhini: Tarsioidea.* W. C. Osman Hill. Interscience, New York; University Press, Edinburgh, 1955. xx + 347 pp. 49 illus., 14 plates. $9.50.

The first volume of this review of the *Primates* by the prosector of the London Zoo was published in 1953; it dealt with the grade Strepsirhini (suborders Lemuroidea and Lorisoidea). Of the several volumes planned to complete this project, the second has now appeared. It is concerned in its first 100 pages with a general introduction to the grade Haplorhini, under which Osman Hill classes the remainder of the primates; the rest of the book is confined to a detailed treatment of the suborder Tarsioidea (three species of the single living genus *Tarsius* and 31 genera of Tertiary fossils). Succeeding volumes will cover the final haplorhine suborder Pithecoidea, which contains the platyrrhine and catarrhine primates.

One can now examine Hill's reasons for using Pocock's seldom adopted bipartite division of the primates—namely, into the Strepsirhini and Haplorhini—since he here deals with the tarsioids, the assignment of which is controversial. Throughout the volume he frequently has to exclude *Tarsius* from general statements about "the haplorhines." The author prepares the reader for this on his second page and defends his inclusion of *Tarsius* in the grade with platyrrhine and catarrhine primates by the statement that "*Tarsius* would also prove an exception to most of the rules had it been included with the lemurs." This will probably only reinforce many readers' convictions that this reference work might better have used the more common tripartite division of the order, which gives independent status to the tarsioids, in recognition of the fact that we know too little of them to settle the disputed question of their alliances with the other great suborders of the primates.

The coverage is more broadly biological than the subtitle suggests, but the major part of the volume is anatomical, presenting a compendium from the widespread literature and the personal researches of the author. The first section, reviewing the Haplorhini, repeats much that was presented in the general coverage of the primates in volume 1, and is in turn repeated in the discussion of the genus *Tarsius*. The 150 pages on the tarsier represent a fuller treatment of one genus than will probably be possible for any other. This reflects Hill's interest in this animal, and his review here embodies much personal research. It does not represent a full anatomical monograph to supersede Burmeister's classic treatise or Woollard's paper, but rather reviews and supplements them; the illustrations are devoted largely to features in which Hill has himself taken special interest.

The section on fossil tarsioids reviews the fragmentary record of 48 Paleocene, Eocene, and Oligocene species. The evidence from dental and skeletal fragments is summarized, and about one-third of the genera are illustrated by figures redrawn from the original publications. The taxonomy is inevitably controversial; in the main, Simpson is followed. Thirty-one genera are given tarsioid status, and all but three are assigned to five subfamilies of the family Microchoeridae (Lydekker's name, which Hill prefers to the older and nearly universally used Anaptomorphidae of Cope). A new subfamily, Microchoerinae, combines the old Necrolemurinae and two genera (*Nannopithex* and *Periconodon*) heretofore regarded as too poorly known to permit even family designation. Another genus (*Yumanius*), usually classed as of uncertain family alliance, is placed in the Anaptomorphinae. Three Oligocene genera, the North American *Macrotarsius* and the Chinese *Hoanghonius* and *Adapidium*, are admitted to the Omomyinae, although their status as primates is admittedly precarious. A chart of Tertiary chronology has had the benefit of criticism by Simpson and is a real improvement on the one that was used in the earlier volume.

All interested in the biology of the primates will be thankful to Hill for this review of the Tarsioidea and for his arduous labor in this multivolumed project. Those who have tried for themselves to

gather from the widespread literature some part of this organized synthesis will appreciate the size and complexity of the task. These volumes will represent a milestone in the progress of primatology, but this is not to say that they will constitute a definitive work—too little has been studied for that, and what has been done is too varied and dispersed for one worker to produce a perfect synthesis. Yet each generation needs a current summary, and Hill is preparing the best and most inclusive review to date.

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Lehrbuch und Atlas der Anatomie des Menschen. Rauber-Kopsch. vol. I, *Allgemeines, Skeletsystem, Muskelsystem, Gefässystem*. vol. II, *Eingeweide Nervensystem-Sinnesorgane*. Thieme, Stuttgart, Germany, ed. 19, 1955. vol. I, vii + 736 pp.; vol. II, vii + 768 pp. Illus. $15.35 per volume.

This 19th edition of one of the standard German works on the anatomy of the human body represents an extensive revision. It again appears in two volumes, as in the time of the original author, Rauber. Volume I comprises the histology of the epithelial, connective, muscular, and nervous tissues, a discussion of the body as a whole, the skeleton and joints, the muscular system, and the vascular system. Volume II deals with the thoracic and abdominal viscera, the nervous system, and the organs of special sense.

All the illustrations have been reproduced *de novo* and are now included within the text, and the text itself has undergone extensive alteration. Since the illustrations are truly magnificent and the text is authoritative, the result is an outstanding combined atlas and textbook. The rather high cost of these books, however, seems likely to limit their use in this country. This is unfortunate, since anatomical books of this superior quality are all too rare.

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Progress in Organic Chemistry. vol. 3. J. W. Cook, Ed. Academic Press, New York; Butterworths, London, 1955. viii + 273 pp. $7.80.

This welcome addition to the "Progress series" consists of five chapters entitled: "Total synthesis of steroids," by J. W. Cornforth of the National Institute for Medical Research, London (43 pages, 56 references); "Non-benzenoid aromatic compounds," by W. Baker and J. F. W. McOmie of the University of Bristol (36 pages, 129 references); "The fulvenes," by E. D. Bergmann of the Hebrew University, Jerusalem (90 pages, 359 references); "Organic compounds of lithium," by E. A. Braude of the Imperial College of Science and Technology," University of London (45 pages, 201 references); and "Indole alkaloids," by V. Boekelheide of the University of Rochester and V. Prelog of the Swiss Federal Institute of Technology, Zurich (48 pages, 170 references). The physical aspects of the book, including type, formulas, paper, and binding are good.

Although it could be argued that some of the topics have recently been reviewed —for instance, parts of Chapter 2 by P. L. Pauson [*Quart. Revs. London* **9**, 39 (1955); *Chem. Revs.* **55**, 9 (1955)]—I find the selection attractive and useful. Chapter 1 is a readable and comprehensive account of total synthesis in the steroid field from the early work of Bachmann and coworkers on equilenin to the recent successful efforts of various groups. Considerable attention is devoted to the work carried out at Oxford, although the Harvard, the Merck ("which has the distinction, so far unique, of being stereospecific"), the Ciba, and the two Wisconsin syntheses are extensively discussed. It should be noted that the publication date is 1955, but no references to papers published later than 1953 are included (important papers in 1954 are, for instance: *J. Am. Chem. Soc.* **76**, 5014 and **76**, 3353). Obviously, the recent work of still another group engaged in steroid synthesis could not be included [compare Stork *et al.*, *J. Am. Chem. Soc.* **78**, 501 (1956)].

A review on nonbenzenoid aromatics is timely, and Chapter 2 provides a valuable survey of a fascinating field through 1953; yet, in some respects, the chapter is somewhat disappointing. The treatment is sketchy; for example, under the promising heading of "Heterocyclic benzenoid compounds," one finds 21 lines of discussion (the use of the term *pentavalent nitrogen* on p. 47 is surprising). The cyclobutadiene problem is treated, without critical comments, in ten lines, although a more adequate coverage (two pages) is given for diphenylene. Incidentally, the recent preparation of benzocyclobutene [Cava, *J. Am. Chem. Soc.* **78**, 500 (1956)] does not bear out the implied instability (p. 51) of this structure. Some of the arguments concerning stability, or lack of it, in certain systems —for example, those on pages 63 and 76—are not very enlightening.

The review on fulvenes is excellent and truly comprehensive. In addition to dealing with the preparative aspects of fulvene chemistry, the author devotes considerable attention to the theory of the structure of these compounds; in this respect, the author stresses the results from molecular orbital theory. Regardless of his individual degree of competence in, and inclination toward, these approximate calculations, the reader will find the emphasis on physical data that follows from this approach highly rewarding.

Lithium alkyls, alkenyls, alkynyls and aryls, as well as heterocyclic lithium derivatives and dilithium compounds are treated in Chapter 4. A commendable attempt to rationalize the reactions of organolithiums is made, although in some cases—such as in dealing with additions to unconjugated olefins—the explanations are of necessity vague. This chapter will undoubtedly be widely consulted.

The discussion of indole alkaloids includes the yohimbine, corynantheine-alstonine, cinchonine, and erythrina types. The selection of topics is dictated by sound reasons, and the limited scope of the coverage permits a detailed and fruitful treatment. It is of interest to note that considerable attention is given to structural relationships and biogenetical schemes, in keeping with current trends in alkaloid research.

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Official Methods of Analysis of the Association of Official Agricultural Chemists. William Horowitz, Ed. H. J. Fisher, A. H. Robertson, and Helen Reynolds, Committee on Editing Methods of Analysis. Association of Official Agricultural Chemists, Washington, D.C., ed. 8, 1955. xvi + 1008 pp. Illus. Domestic, $12; foreign, $12.50.

The editorial board charged with the revision of the 1950 edition of this book undoubtedly had a mandate to stay within the confines of a single volume. This they accomplished by the free use of abbreviations and cross references, which sometimes makes the book more difficult to use than it would be if more space had been available.

The book covers methods for the analysis of agricultural materials ranging from fertilizer and cattle feeds to cosmetics, hormones, and drugs. The general coverage is nearly the same as that of the 1950 edition, but the field in each category has been somewhat broadened. Many of the older methods have been discarded, and newer techniques have been introduced. Practically every chapter shows important changes and improvements. Methods have been simplified or improved by the introduction of

instrumentation, chromatography, flame photometry, spectrophotometric and fluorometric determinations, and spectrographic techniques. Courage and hard labor were required to develop the portions of the book dealing with hormones and the newer pesticides.

An analyst dealing with agricultural and related products needs this book. Since the wealth of information contained in it gives the impression that the book is bursting at the seams, the editorial board may face the task of issuing two volumes in 1960.

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Preventive Medicine in World War II. vol. III, *Personal Health Measures and Immunization*. Ebbe Curtis Hoff, Ed. Office of the Surgeon General, Department of the Army, Washington, D.C., 1955 (order from Supt. of Documents, GPO, Washington 25). 394 pp. $3.25.

This volume has eight chapters covering manpower selection, personal hygiene, clothing, nutrition, malnutrition and deficiency diseases, preventive psychiatry, accidental trauma, and army immunization progress. The four appendixes deal with the administrative requirements for vaccination for yellow fever, cholera, and typhus and for immunization of overseas areas by diseases.

New Books

Automata Studies. C. E. Shannon and J. McCarthy. Princeton University Press, Princeton, N.J., 1956. 285 pp. Paper, $4.

The Legacy of Sigmund Freud. Jacob A. Arlow. International Universities Press, New York, 1956. 96 pp. $2.

The Unknown–Is It Nearer? Eric J. Dingwall and John Langdon-Davies. New American Library, New York 22, 1956. 160 pp. Paper, $0.35.

Bacterial Anatomy. Sixth symposium of the Society for General Microbiology held at the Royal Institution, London, April 1956. E. T. C. Spooner and B. A. D. Stocker, Eds. Cambridge University Press, New York, 1956. 360 pp. $6.

Birthplace of the Winds. Ted Bank, II. Crowell, New York, 1956. 274 pp. $4.50.

The Conquest of Mt. McKinley. Belmore Browne. Houghton Mifflin, Boston, new ed., 1956. 381 pp. $6.

Deliver Us from Evil. The story of Viet Nam's flight to freedom. Thomas A. Dooley. Farrar, Straus and Cudahy, New York, 1956. $3.50.

The Descent of Pierre Saint-Martin. Norbert Casteret. Translated by John Warrington. Philosophical Library, New York, 1956. 160 pp. $4.75.

Rockets and Guided Missiles. John Humphries. Macmillan, New York, 1956. 229 pp. $6.

Irrationalzahlen. Oskar Perron. Chelsea, New York, ed. 2, 1951. 199 pp. Cloth, $3.25; paper, $1.50.

Introduction to the Theory of Groups of Finite Order. Robert D. Carmichael. Dover, New York (unaltered republication of ed. 1, 1937), 1956. 447 pp. Cloth, $3.95; paper, $2.

Electric Circuit Theory and the Operational Calculus. John R. Carson. Chelsea, New York, ed. 2, 1953. 197 pp. Cloth, $3.95; paper, $1.88.

Color Atlas of Oral Pathology. Histology and embryology, developmental disturbances, diseases of the teeth and supporting structures, diseases of the oral mucosa and jaws, neoplasms. U.S. Naval Dental School, National Naval Medical Center. Lippincott, Philadelphia, 1956. 188 pp. $12.

New Concepts in Flowering-Plant Taxonomy. J. Heslop-Harrison. Harvard University Press, Cambridge, Mass., 1956. 135 pp. $1.25.

Grundlagen der Allgemeinen Vitalchemie in Einzeldarstellungen. vol. I, *Die physikalische Grundlage des lebenden Systems: Atom und Molekül*. Karl Kaindl. 1955. 201 pp. S.192. vol. II, *Die physikalisch-chemische Grundlage des lebenden Systems: Ordnungszustände und Reaktionsgeschehen*. Karl Kaindl and Stefan Holzel. 1956. 138 pp. S.186. Urban & Schwarzenberg, Vienna–Innsbruck, Austria.

Famous Problems of Elementary Geometry. F. Klein. Translated by Wooster Woodruff Beman and David Eugene Smith. Notes by Raymond Clare Archibald. Dover, New York, rev. ed. 2, 1956. 92 pp. Cloth, $1.50; paper, $1.

Exceptional Children. Florence L. Goodenough assisted by Lois M. Rynkiewicz. Appleton-Century-Crofts, New York, 1956. 428 pp. $4.50.

Experimental Thermochemistry. Measurement of heats of reaction. Prepared under the International Union of Pure and Applied Chemistry by the Subcommission of Experimental Thermochemistry. Frederick D. Rossini, Ed. Interscience, New York, 1956. 326 pp. $7.80.

The Thirteen Books of Euclid's Elements. Translated from the text of Heiberg with introduction and commentary by Thomas L. Heath. 3 vols. Dover, New York, rev. ed. 2, 1956. 432 pp.; 436 pp.; 546 pp. Paper, $5.85 (set of 3 vols.).

Great Men. Psychoanalytic studies. Edward Hitschmann. Sydney G. Margolin, Ed. International Universities Press, New York, 1956. 278 pp. $4.

Intermediate Analysis. An introduction to the theory of functions of one real variable. John M. H. Olmsted. Appleton-Century-Crofts, New York, 1956. 305 pp. $6.

The Human Heredity Handbook. Amram Scheinfeld. Lippincott, Philadelphia, 1956. 276 pp. $3.95.

Methods in Personality Assessment. Human behavior in complex social situations. George G. Stern, Morris I. Stein, Benjamin S. Bloom. Free Press, Glencoe, Ill., 1956. 271 pp. $6.

Miscellaneous Publications

(Inquiries concerning these publications should be addressed, not to Science, *but to the publisher or agency sponsoring the publication.)*

Bryozoa of the United States Navy's 1947–1948 Antarctic Expedition, I–IV. Proceedings of the U.S. National Museum, vol. 105, No. 3358, 97 pp. Mary D. Rogick. Smithsonian Institution, Washington, D.C., 1956.

New Discoveries. Wonders in our planetary world. Frederick Benario. Hillcrest Publishing Corp., Flushing, N.Y., 1956. 68 pp.

The Physiology of the Melanophores of the Isopod Idothea Exotica. Tulane Studies in Zoology, vol. 3, No. 8. Milton Fingerman. 10 pp., $0.30. *Osmotic Behavior and Bleeding of the Oyster Crassostrea Virginica*. vol. 3, No. 9. Milton Fingerman and Laurence D. Fairbanks. 18 pp. $0.50. Tulane University, New Orleans, La., 1956.

General Education in Engineering. A report of the humanistic-social research project. American Society for Engineering Education, 1956 (order from W. Leighton Collins, University of Illinois, Urbana). 122 pp. $0.25.

Ecological Monographs, Twenty-Year Index, Volumes 1–20, 1931–1950. Donald B. Lawrence and Elizabeth G. Lawrence, Committee on Index. Duke University Press, Durham, N.C., 1956. 44 pp. $2.50.

General Features of Algal Growth in Sewage Oxidation Ponds. Publ. No. 13. State Water Pollution Control Board, Sacramento, Calif., 1955. 48 pp. $0.75.

Recherches sur la constitution de l'os adulte. J. Vincent. Université Catholique de Louvain, Brussels, Belgium, 1955. 153 pp.

Scientific Institutions of Mexico. vol. 3. UNESCO, Montevideo, Uruguay, 1955. 76 pp.

Development, Growth, and State of the Atomic Industry. Hearings before the Joint Committee on Atomic Energy, Congress of the United States, Eighty-Fourth Congress, second session. pt. 1, section 202, Statutory Hearings. 7, 8, 15, 16, and 23 February 1956. Supt. of Documents, GPO, Washington 25, 1956. 320 pp. $0.75.

Symposium on Marine and Fresh-Water Plankton in the Indo-Pacific. Bangkok, Thailand, 25 and 26 January 1954. Indo-Pacific Fisheries Council, Bangkok, and Science Co-operation Office for South East Asia, Djakarta, Indonesia, 1954. 111 pp. $1.

Ascites Tumors as Tools in Quantitative Oncology. Annals, vol. 63, art. 5. Roy W. Miner, Ed. 394 pp. New York Academy of Sciences, New York, 1956.

On the Status and Relations of Crocodylus Mindorensis. Philippine Zoological Expedition 1946–1947. Fieldiana: Zoology, vol. 33, No. 5. Karl P. Schmidt. 5 pp. $0.15. *A New Genus of Minute Fungus-Pore Beetles from Oregon. Coleoptera: Ptiliidae*. vol. 34, No. 38. Henry S. Dybas. 8 pp. $0.20. *A New Snake of the Genus Tantilla from West Texas*. vol. 34, No. 39. Sherman A. Minton, Jr. 4 pp. $0.15. *Dinosaurs, Predator and Prey*. Rainer Zangerl. 12 pp. $0.25. Chicago Natural History Museum, Chicago, Ill., 1956.

Scientific Meetings

Preliminary Announcement of the Seventh New York Meeting

Since its founding more than a century ago, the American Association for the Advancement of Science has held 122 national meetings. One of the fundamental purposes for which the association was founded, in September 1848, still endures: ". . . by periodical and migratory meetings to promote intercourse between those who are cultivating science. . . ." In recent years the association has also increasingly recognized its responsibility to inform the general public on scientific developments and its obligation to assist all organizations concerned in the encouragement of qualified young people to prepare for, and enter, careers in science. All of these objectives will influence the programs this year.

For its 123rd meeting—the annual meeting of 1956, 26–31 Dec.—the association will return to New York, for the seventh time, and after an interval of 7 years. As in 1949, this large assemblage of research scientists, teachers, research directors, university presidents, engineers, and other science-minded professional men and women will occupy the five hotels closely grouped around the Pennsylvania Railroad Station. The Statler and New Yorker are among the largest in the nation; there are available, with the Sheraton-McAlpin, Governor Clinton, and Martinique, 6700 rooms for transient guests and an exceptional number and variety of session rooms, all of them committed to the use of the AAAS and the participating societies. Since these five hotels are such close neighbors—interconnected by tunnels in three instances—a particularly unified, convenient, and time-saving meeting is assured.

Center of the group, the Hotel Statler will be AAAS Headquarters and site of all general events and the large-scale exhibits. The mezzanine of the Statler not only has a large ballroom (capacity 1800) and other session rooms, but it can also accommodate the AAAS Main Registration-Information Center, AAAS Office, AAAS Press Room, AAAS Science Theatre, Zoologists' Lounge, and the Annual Exposition of Science and Industry, sponsored by the association for the 33rd time. These exhibits of the latest in the materials and tools that scientists use—and of the technical accomplishments of large industries—will occupy the Ivy Suite, Foyer, and Georgian Room just opposite the ballroom. With so many session rooms in one hotel—most of them on the mezzanine level—and all the hotels so near one another, the exhibits can be visited repeatedly, during any spare moment, and with a maximum of convenience. Exhibitors have already recognized this fact and, at this time, more than 6 months in advance of the meeting, most of the available boothspace has been rented.

Among the general events scheduled for the ballroom and adjacent areas are the AAAS Presidential Address and Reception on the evening of 28 Dec. At this event, Paul B. Sears will preside, and George W. Beadle will give his retiring address. The distinguished evening lectures of RESA, Sigma Xi, and the United Chapters of Phi Beta Kappa, as well as the AAAS Smoker on the evening of 29 Dec., are all scheduled for the ballroom or adjacent Keystone Room. The two afternoons of 27 and 28 Dec. have been set aside for the two parts of the AAAS General Symposium, "Moving frontiers of science," organized by the Committee on AAAS Meetings. Because of the general interest of this program, the details of which will be announced later in a special release, all AAAS sections and most of the participating societies have not scheduled any sessions concurrent with it. This symposium will be in the Statler ballroom.

The tenth annual Junior Scientists Assembly, sponsored by the association's Academy Conference, a full afternoon program exclusively for high-school students interested in careers in science, will be held in the large auditorium of the American Museum of Natural History on 27 Dec. Following the pattern of the Berkeley meeting's assembly, with the theme this year, "What makes a scientist," there will be an appropriate address, an industrial science show, a panel, and a concluding illustrated lecture. Program chairman is Zachariah Subarsky of the Bronx High School of Science.

Those concerned with various aspects of communications will find much to interest them in the six sessions of the fifth Conference on Scientific Editorial Problems, arranged by a committee headed by J. G. Adashko, Ford Instrument Company, and in the national meeting of the American Documentation Institute. It is probable that these programs will be cosponsored by one or more of the relatively new societies on technical writing. An interesting exhibit of the latest equipment for the storage and retrieval of information will be jointly sponsored by the ADI and the National Bureau of Standards. A noteworthy event of this year's program in chemistry will be the silver anniversary of the AAAS-Gordon Research Conferences, culminating in a dinner at which Glenn T. Seaborg, 1951 Nobel prize winner, will speak.

As the following synopsis of programs indicates, there will be interesting and important programs in all principal fields of science. In addition to the sessions for contributed papers that meet the needs of specialists, there will be a rich variety of symposia, and among these symposia there will be a number that are interdisciplinary and explore relatively neglected scientific areas—a type of program especially appropriate for an association of 264 affiliates and well over 50,000 individual members.

It is already apparent that the 123rd meeting will be one of the most significant in the long annals of the 108-year-old AAAS—and the attendance will be commensurate. The 18 sections of the association by themselves assure a large and diversified meeting but, in addition, some 40 societies and organizations are arranging programs of their own, and more than 50 others are participating as cosponsors. Fortunately, the session rooms of the Penn Zone hotels are sufficient in number to house nearly all the sessions and large enough to minimize crowding. The Hotel New Yorker will be headquarters for the Entomological Society of America; the Sheraton-McAlpin will house the science teaching societies; and the History of Science Society will be based at the Hotel Governor Clinton. All hotel headquarters assignments will be announced in the association's journals in July, at which time the advertising pages will begin to carry housing reservation and advance registration coupons. As in recent years, advance registrants will receive the book-size General Program-Directory early in December by first-class mail.

A synopsis of programs follows. The names given within parentheses are program chairmen.

Mathematics (A)

The *Association for Computing Machinery* (J. P. Nash, University of Illinois) is planning several sessions and

the *Society for Industrial and Applied Mathematics* (Donald L. Thomsen, International Business Machines) is arranging a program of invited papers. Both organizations are meeting with the AAAS for the first time, and details are not yet available. It is anticipated that Section A (Rudolph E. Langer, University of Wisconsin) will cosponsor one or more of these sessions and will schedule a vice-presidential address.

Physics (B)

Section B (J. Howard McMillen, National Science Foundation) is organizing symposia on "Optics and oriented nuclei" (William B. Hawkins, Jr., Yale University), "Optical absorption in solids" (William F. Meggers, National Bureau of Standards), "Diffusion in solids" (H. B. Huntington, Rensselaer Polytechnic Institute), and "Crystal growth (Nicholas Cabrera, University of Virginia); a fifth symposium on biophysics is under consideration. The Physicists' Dinner will be cosponsored by *Sigma Pi Sigma*, and the retiring vice-presidential address of Section B will be given by Alan T. Waterman of the National Science Foundation.

The *American Meteorological Society* (Kenneth Spengler, AMS) will cosponsor the Association of American Geographers' invited papers on climatology and other appropriate sessions.

Chemistry (C)

Section C's (Ed. F. Degering, Quartermaster Research and Development Laboratories, Natick, Mass.) full program includes sessions for contributed papers and symposia (Karl Folkers, Merck, & Co.), the cosponsorship of Section Nd's symposium on "Antienzymes," and a vice-presidential address by Folkers. The symposia are on "Substances with selective toxicity" (Werner Braun, Rutgers University), 27 Dec.; "Steroids" (Boyd Woodruff, Merck & Co.), 28 Dec.; and "Organic chemistry" (Ellis Brown, Seton Hall University), 29 Dec. As mentioned earlier, the *AAAS-Gordon Research Conferences* will celebrate their silver anniversary with a dinner on 27 Dec., at which Glenn T. Seaborg will speak. *Alpha Chi Sigma* (H. G. Seavey, secretary of the New York Professional Chapter) is planning a meal function for all chemists.

Astronomy (D)

The *American Astronomical Society* (J. Allen Hynek, Ohio State University), for the first time in many years, will schedule its national meeting with the AAAS. The Hayden Planetarium of the American Museum of Natural History is cooperating. The Helen Warner prize lecture will be given by Harold Johnson of the Lowell Observatory. With the AAS providing a full program of sessions for contributed papers and other events, Section D's program will be restricted to cosponsorship of the AAS program and the retiring vice-presidential address of Seth B. Nicholson of the Mount Wilson Observatory.

Geology and Geography (E)

Section E (Robert L. Nichols, Tufts University) will have sessions for contributed papers in geology; a four-session symposium, "Geochronometry" (J. Laurence Kulp, Columbia University), one session of which, on "Carbon dating," will be cosponsored by Section F; "Ground water" (A. Nelson Sayre, U.S. Geological Survey); and "Appalachian structure and stratigraphy" (Kurt E. Lowe, City College, New York)—all cosponsored by the *Geological Society of America*. Symposia on "Carbonate sedimentation" and "Uranium geology," as well as a panel on the International Geophysical Year, are being considered. Section E will cosponsor the sessions of the special meeting of the *Association of American Geographers* (Peter M. Stern, Conservation Foundation), with the New York Metropolitan Division as host, which will include sessions for contributed papers in geography and invited papers on climatology. Section E's customary Geologists' Smoker will include the retiring vice-presidential address of Carl Tolman. The *National Geographic Society* will have its usual excellent lecture and accompanying film —one of the special evening sessions— and the *National Speleological Society* (Brother G. Nicholas, Cumberland, Md.) again will hold a general session for contributed papers and a social hour.

Zoological Sciences (F)

The program of Section F (H. H. Plough, Amherst College) includes a symposium on "Museum techniques" cosponsored by the *American Museum of Natural History* (Gordon Reekie, manager of exhibition and construction, American Museum of Natural History); cosponsorship of the two-session symposium, "Communication in the social insects," of the International Union for the Study of Social Insects; a symposium, "Problems of aging" (Howard J. Curtis, Brookhaven National Laboratory)—topics: "Aging in lower organisms," "Physiological aspects of aging in mammals," "Aging in populations," and "Radiation-induced aging"; a symposium, "The biochemistry of the cell nucleus" (A. W. Pollister, Columbia University), jointly with the *Genetics Society of America*—topics and speakers are "Introduction," A. W. Pollister; "The correlation of nucleic acid content with chromosome complement," Cecilie Leuchtenberger; "The time of synthesis of desoxyribose nucleic acid," J. Herbert Taylor; "Changes in the interphase nucleus with cellular function," Max Alfert; and "Chemical studies of the giant chromosomes of Diptera," George T. Rudkin. Section F will cosponsor "Carbon dating," part II of Section E's symposium on "Geochronometry" (J. Laurence Kulp, Columbia University); the joint symposium of the *New York Zoological Society* and the *New York Academy of Sciences* (Ross F. Nigrelli, New York Zoological Society); the symposium of the *American Society of Zoologists* (Rudolph T. Kempton, Vassar College); and a symposium, jointly with Section G, on "Problems of aging in plants and animals." The Zoologists' Luncheon for all zoologists will feature the vice-presidential address of Bentley Glass. Contributed papers submitted to Section F will be joint with the societies just mentioned or immediately following.

The 4 days of concurrent sessions of the annual national meeting of the *Entomological Society of America* (P. W. Oman, Plant Industry Station, Beltsville, Md.), which last met with the association in 1947, are scheduled for 27–30 Dec., inclusive, at the Hotel New Yorker. The *Herpetologists League* (James A. Fowler, Academy of Natural Sciences of Philadelphia) is planning a regional meeting of contributed papers. The *International Union for the Study of Social Insects, North American Section* (T. C. Schneirla, American Museum of Natural History), in addition to the symposium on "Communication in the social insects"—part I, "Perspectives on fact and theory for the principal social insects" and part II, "Special problems concerning techniques, modalities and potentialities"—will sponsor a symposium, "The effects of radiation on insects" (Orlando Park, Northwestern University), jointly with the Ecological Society of America. The national annual meeting of the *Society of Systematic Zoology* (R. E. Blackwelder) will follow the pattern of former meetings with the association, with sessions for contributed papers, one or more panels or symposia —one of them jointly with the Entomological Society of America—evening lectures, and a business meeting. A feature will be the annual SSZ Library and Lounge for all zoologists.

The New York Zoological Park (Bronx Zoo) will sponsor a daily guided tour throughout the meeting period, 27–31 Dec., beginning at the administration building at 11 A.M. (John Tee-Van, director).

Biological Sciences (FG)

The *Ecological Society of America* (Murray F. Buell, Rutgers University) will have sessions for contributed papers, two sessions of invited papers, "Ecology in the Northeast and its applications," and a group of papers on animal behav-

ior and sociobiology (J. P. Scott, Jackson Memorial Laboratory); the symposium, "The effects of radiation on insects," of the International Union for the Study of Social Insects and the grassland ecology part of Section O's symposium on grasslands will be cosponsored. The symposium of the Genetics Society of America has been mentioned under Section F.

The *Society for the Study of Evolution* (Harlan Lewis, University of California at Los Angeles), which last met with the AAAS in 1949, in addition to sessions for contributed papers and a business meeting, will have a symposium, "Biotic communities in the past and today," with Jens C. Clausen as chairman. Titles of papers and speakers are "Genic variability in relation to environment," J. C. Clausen; "Migration of Cenozoic forest communities in North America," Erling Dorf; "Rise of the grass-eating mammals," Joseph T. Gregory; and "Man changing the environment"; this program will be cosponsored by the *Society of Vertebrate Zoology* and other societies.

It is expected that the *American Society of Naturalists* (Bruce Wallace, Cold Spring Harbor, N.Y.) will either arrange a symposium or cosponsor one in the F, FG, or G series.

The annual national meeting of the *National Association of Biology Teachers* (John Breukelman, State Teachers College, Emporia, Kan.) will begin with a business meeting, 26 Dec. It will include three general programs, a luncheon on 27 Dec., a joint session with the other science teaching societies, and a session at the American Museum of Natural History. A field trip with the American Nature Study Society on 30 Dec. will conclude the meeting. The *Society of General Physiologists* (Abraham Shanes, National Institutes of Health) plans a symposium and one or more sessions for contributed papers.

Botanical Sciences (G)

Section G (Barry Commoner, Washington University) will have a two-session symposium, "Problems of aging in plants and animals" (Paul J. Kramer, Duke University) jointly with Section F; and a second symposium, "Some unsolved problems in biology"—for example, the chemistry of inheritance, mechanisms of growth and development—(Barry Commoner) cosponsored by Section F and various societies including the *Botanical Society of America* and commemorating this society's golden anniversary. Section G will cosponsor Section O's grassland symposium. The vice-presidential address by Paul J. Kramer will follow the Botanists' Dinner, 27 Dec., a special occasion further celebrating the 50th anniversary of the Botanical Society of America. Sessions for contributed papers in plant ecology, plant physiology, and general botany will be held jointly with the Ecological Society of America and the *Torrey Botanical Club* (David Keck, New York Botanical Garden). The Torrey Botanical Club will also arrange a program, probably in the field of plant taxonomy.

Anthropology (H)

The full program of Section H (Gabriel Lasker, Wayne University College of Medicine) includes sessions for contributed papers; a symposium to commemorate the 100th anniversary of the discovery of the Neanderthal man (Loren C. Eiseley, University of Pennsylvania, and William L. Straus, Jr., Johns Hopkins University), sponsored jointly with the *American Institute of Human Palaeontology*; a two-session symposium, "Man in the tropics" (Vera Rubin, Columbia University), with speakers from both the United States and Caribbean areas; an Anthropologists' Dinner with one or more addresses by W. Montague Cobb and perhaps other recent vice presidents of Section H. Section Nd's symposium, "Forensic dentistry," will be cosponsored.

Psychology (I)

Section I (Conrad G. Mueller, Columbia University) has arranged sessions for six groups of invited papers, four of which are "Experimental psychopathology," "Physiological mechanisms of motivation and reward," "Sensory functions," and "The place of experimental psychology in anthropological field work." It is anticipated that there will be sessions for contributed papers and that Section I will cosponsor parts of Section N's symposium, "Evolution of nervous control from amoeba to man." The vice-presidential address will be given by Clarence H. Graham of Columbia University.

Social and Economic Sciences (K)

Section K's symposium, "The impact of the natural sciences on the social sciences: an interpretation" (Donald P. Ray, George Washington University), will be of general interest. It is cosponsored by the *American Political Science Association* and the *American Sociological Society*. Section K will cosponsor the symposium, "Science and national security" (Benjamin H. Williams, Industrial College of the Armed Forces), of the *National Academy of Economics and Political Science* with the collaboration of *Pi Gamma Mu*, the national honorary society in the social sciences, which, it is anticipated, will have a dinner for the speakers of Section K.

History and Philosophy of Science (L)

The program of Section L (Jane M. Oppenheimer, Bryn Mawr College) comprises two sessions for contributed papers, a joint session and dinner with the History of Science Society, a business meeting, the vice-presidential address of Henry Guerlac, and a two-session symposium, "Science and ethics" (Joseph Mayer, Miami University, Ohio), probably cosponsored by the *Philosophy of Science Association*, which plans five sessions on measurement. Section L will cosponsor the special meeting of the *American Philosophical Association, Eastern Division* (John Wild, Harvard University) commemorating the 100th anniversary of the birth of Sigmund Freud.

The annual national meeting of the *History of Science Society* (Pearl Kibre, Hunter College) begins with business meetings on 27 Dec.; includes the symposium, "The interaction of science and technology," joint with Section L, and a luncheon and report on the international conference, 28 Dec.; and concludes, 29 Dec., with two symposia, "The impact of ancient science on the Middle Ages" and "The history of medicine: interpretations and advocates." The *Society for the Advancement of General Systems Theory* (Ludwig von Bertalanffy, Mt. Sinai Hospital, Los Angeles) will have a business meeting and a session for contributed papers, 29 Dec., and a symposium, 30 Dec.

Engineering (M)

Section M (Clarence E. Davies, ASME) has set up a program committee to plan and implement a three-session symposium (Irving P. Orens, Newark College of Engineering) entitled "Man and his physical environment," scheduled for 26 and 27 Dec. Part I will deal with "The present integration of man and machines"; Part II, "The future integration and necessity for new machines"; and part III, "Machines and progress in the mechanical translation of languages." The *Engineering Manpower Commission* will cosponsor the sessions of the Conference on Scientific Manpower.

Medical Sciences (N)

As in previous years, Section N will have a four-session symposium, the participants of which come from all parts of the continent. This symposium is scheduled for 29 and 30 Dec. This year's subject "Evolution of nervous control from amoeba to man" (Bernard B. Brodie, National Institutes of Health), will range from the rudiments of intracellular phenomena in protozoans through intercellular communication and neurohumors in both invertebrates and vertebrates to the basic actions of drugs on animal and human behavior; included will be the vice-presidential address of Irvine H. Page, and the announcements of the 12th Theobald Smith award, given by Eli Lilly and Company, and the second AAAS-Anne Frankel

Rosenthal Memorial Award in Cancer Research. Part of this symposium may be cosponsored by the Society of General Physiologists and Section I. Section N will cosponsor a variety of appropriate programs.

Alpha Epsilon Delta (Maurice L. Moore, national secretary) will have its customary annual luncheon and a speaker of prominence. Details of the special programs of the *American Association of Hospital Consultants* (E. Dwight Barnett, Columbia University), the *American Psychiatric Association* (Benjamin Pasamanick, Ohio State University Health Center), and the *American Physiological Society* (Fred A. Hitchcock, Ohio State University) are not yet available.

Dentistry (Nd)

On 28 Dec., Section Nd (George C. Paffenbarger, American Dental Association Research Fellowship, National Bureau of Standards) will have sessions for contributed and invited papers, "Contributions of science to everyday practice." On 29 Dec., there will be a symposium, "Forensic dentistry" (W. M. Krogman, University of Pennsylvania), cosponsored by Sections H and N; a luncheon; a second symposium, "Antienzymes," cosponsored by Sections C, N, and Np; and a business meeting. The entire program of the section will be cosponsored by the *American College of Dentists*, the *American Dental Association*, and the *International Association for Dental Research, North American Division*.

Pharmacy (Np)

The full program of Section Np (John E. Christian, School of Pharmacy, Purdue University) begins 26 Dec. with an evening session for contributed papers and continues 27 Dec. with the vice-presidential address of Rudolph H. Blythe, contributed papers, and a symposium, "The significance of cosmetics in medical practice," cosponsored by the *Committee on Cosmetics of the American Medical Association*. On 28 Dec. there will be a symposium, "Tablet manufacture," and papers, and, on 29 Dec., the Hospital Pharmacy program and Section Nd's "Antienzymes." Section Np's entire program will be cosponsored by the *American Association of Colleges of Pharmacy*, the *American College of Apothecaries*, the *American Pharmaceutical Association, Scientific Section*, and the *American Society of Hospital Pharmacists*.

Agriculture (O)

Section O (H. B. Sprague, Pennsylvania State University) will have a four-session symposium, "Grasslands in our national life," 29 and 30 Dec. Part I deals with "Forage utilization and related animal nutrition problems"; part II, "Forage production in humid regions"; part III, "Applications of plant sciences to grasslands"; and part IV, "Grassland machinery, equipment, and irrigation systems." Among the many organizations expected to cosponsor appropriate portions of this symposium are Section G, American Dairy Science Association, American Institute of Nutrition, American Phytopathological Society, American Society of Agricultural Engineers, American Society of Agronomy, American Society of Animal Production, American Society of Biological Chemists, American Society of Plant Physiologists, American Veterinary Medical Association, Botanical Society of America, Ecological Society of America, Entomological Society of America, Farm Equipment Institute of America, Genetics Society of America, Soil Conservation Society of America, and Soil Science Society of America.

Industrial Science (P)

Section P (Allen T. Bonnell, Drexel Institute of Technology) will hold a two-session symposium and a luncheon session at which Earle L. Rauber of the Atlanta Federal Reserve Bank will give the vice-presidential address.

Education (Q)

The program of Section Q (Herbert A. Smith, University of Kansas) includes two sessions joint with the *International Council for Exceptional Children*, 26 Dec.; two sessions joint with the *American Educational Research Association*, 29 Dec.; some four sessions for contributed papers, 29–31 Dec.; a business meeting, 30 Dec.; and the vice-presidential address of Dean A. Worcester. This section will cosponsor appropriate sessions of the programs of the science teaching societies—all of which (J. Darrell Barnard, New York University, Washington Square) are cosponsoring the AAAS General Symposium, "Moving frontiers of science," holding a joint mixer the evening of 26 Dec. and a joint session the evening of 27 Dec.

Additional sessions of the regional meeting of the *National Science Teachers Association* (Alfred D. Beck, New York Board of Education) are tours, 26 Dec.; a Business-Industry Luncheon, 27 Dec.; and concurrent sessions, 28 and 29 Dec. The *National Association for Research in Science Teaching* (Nathan Washton, Queens College) will meet on 27 Dec. and will also participate in the joint session of the science teaching societies that evening. The *AAAS Cooperative Committee on the Teaching of Science and Mathematics* (Morris Meister, Bronx High School of Science) will probably hold a panel discussion on the proposed extension of the Smith-Hughes Act, which would provide federal subsidies for science and mathematics teachers; and it will cosponsor the Junior Scientists Assembly of the Academy Conference.

Science in General (X)

The Annual *Academy Conference* (Leland H. Taylor, West Virginia University), composed of delegates and other members of the 41 academies affiliated with the association, will hold a day of sessions, 29 Dec., and will sponsor the tenth annual Junior Scientists Assembly.

Details of the annual national meeting of the *American Documentation Institute* (James W. Perry, Western Reserve University), which is meeting with the AAAS for the first time, are not yet available; one feature, however, will be an exhibit of the latest equipment for the storage and retrieval of data, jointly sponsored by the ADI and the National Bureau of Standards. The *American Geophysical Union* (Waldo E. Smith, AGU) probably will cosponsor the session on climatology of the Association of American Geographers and other appropriate programs within the wide range of the interests of its membership.

The annual national meeting of the *American Nature Study Society* (Richard L. Weaver, University of Michigan) includes an opening session on the afternoon of 26 Dec. and the joint mixer that evening; the joint session of the science teaching societies, 27 Dec.; a session, 28 Dec.; and, with NABT a joint session, 29 Dec., and a joint field trip, 30 Dec. The ANSS banquet and showing of kodachromes is scheduled for the evening of 29 Dec.

The fifth *Conference on Scientific Editorial Problems* (J. G. Adashko, Ford Instrument Company) will hold six (nonconcurrent) sessions on various aspects of scientific and technical writing, editing, and publishing; it is expected that one of these sessions will be concerned with foreign translation problems. The program will be coordinated with the sessions of the American Documentation Institute so that potential conflicts are eliminated or minimized.

The recurrent *Conference on Scientific Manpower* (Thomas J. Mills, National Science Foundation) is scheduled for 4 P.M., 26 Dec. As in previous years, it will be cosponsored by the *Engineering Manpower Commission*, the *Scientific Manpower Commission*, the *National Academy of Sciences–National Research Council*, and the *National Science Foundation*.

The national meeting of *Sigma Delta Epsilon*, graduate women's science fraternity (Clyde Chandler, Boyce Thompson Institute), begins with a business meeting, 26 Dec. and includes the annual

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dinner and grand chapter meeting on 27 Dec., a luncheon for all women in science on 29 Dec., and probably a tea on 30 Dec. A headquarters room will be maintained throughout the meeting period.

The *National Association of Science Writers* (Roland H. Berg, *Look* Magazine) will have its annual symposium and a business meeting with the AAAS. The annual address and award of the William Procter prize of the *Scientific Research Society of America* is scheduled for the evening of 26 Dec., preceding the society's joint luncheon with the Society of the Sigma Xi and the annual convention of RESA on 27 Dec. The annual address of the *Society of the Sigma Xi* will be held the evening of 27 Dec., following the 57th annual convention of the society on that day. The 17th annual lecture of the *United Chapters of Phi Beta Kappa* is scheduled for the evening of 27 Dec.

Societies and organizations participating in the AAAS meeting are as follows.

National annual meetings: Academy Conference; American Astronomical Society; American Documentation Institute; American Nature Study Society; Conference on Scientific Editorial Problems; Conference on Scientific Manpower; Entomological Society of America; History of Science Society; National Association of Biology Teachers; Scientific Research Society of America; Sigma Delta Epsilon; Society for the Advancement of General Systems Theory; Society of the Sigma Xi; Society for the Study of Evolution; Society of Systematic Zoology.

Special or regional meetings, with programs: AAAS Cooperative Committee on the Teaching of Science and Mathematics; AAAS-Gordon Research Conferences; Alpha Chi Sigma; Alpha Epsilon Delta; American Association of Hospital Consultants; American Philosophical Association, Eastern Division; American Psychiatric Association; American Society of Zoologists; Association of American Geographers; Association for Computing Machinery; Ecological Society of America; Genetics Society of America; Herpetologists League; International Union for the Study of Social Insects, North American Section; National Academy of Economics and Political Science; National Association for Research in Science Teaching; National Association of Science Writers; National Geographic Society; National Science Teachers Association; National Speleological Society; New York Academy of Sciences; New York Zoological Park; New York Zoological Society; Pi Gamma Mu; Society of General Physiologists; Society for Industrial and Applied Mathematics; Torrey Botanical Club; United Chapters of Phi Beta Kappa.

Cosponsors: American Association of Colleges of Pharmacy; American College of Apothecaries; American College of Dentists; American Dairy Science Association; American Dental Association; American Educational Research Association; American Geophysical Union; American Institute of Human Palaeontology; American Institute of Nutrition; American Medical Association, Committee on Cosmetics; American Meteorological Society; American Museum of Natural History; American Pharmaceutical Association, Scientific Section; American Physiological Society; American Phytopathological Society; American Political Science Association; American Society of Agricultural Engineers; American Society of Agronomy; American Society of Animal Production; American Society of Biological Chemists; American Society of Hospital Pharmacists; American Society of Naturalists; American Society of Plant Physiologists; American Sociological Society; American Veterinary Medical Association; Botanical Society of America; Engineering Manpower Commission; Farm Equipment Institute; Geological Society of America; International Association for Dental Research, North American Division; International Council for Exceptional Children; National Academy of Sciences–National Research Council; National Bureau of Standards; National Science Foundation; Philosophy of Science Association; Scientific Manpower Commission; Sigma Pi Sigma; Society of Vertebrate Zoology; Soil Conservation Society of America; Soil Science Society of America.

RAYMOND L. TAYLOR
Associate Administrative Secretary, AAAS

Meetings Notes

■ A conference on the Management of Industrial Research will be held 11–15 June under the auspices of Columbia University at its 100-acre Harriman Campus in Harriman, N.Y. Director of the conference will be Robert T. Livingston, professor of industrial and management engineering at Columbia and a former director of research at the Long Island Lighting Company.

The conference will study methods for the design of research programs from the viewpoint of integrating them with other aspects of company operations. Two special panel discussions have been planned: "Human rélations in research," moderated by Lyman Bryson, professor emeritus of education at Columbia University Teachers College; and "Operations research does a job on industrial research," moderated by David B. Hertz, director of operations research for Popular Merchandise, Inc.

In considering the design of research

programs, participants and speakers will discuss methods of research, problem formulation and analysis, the translation of results into operation, and the coordination of research efforts to aid management in making effective decisions. In addition to formal presentations, clinic sessions will be held at which participants will pose and solve their own problems under the direction of trained group leaders.

Principal speakers will include C. C. Furnas, Assistant Secretary of Defense for Research and Development; Rear Admiral Rawson Bennett, chief of Naval Research; T. F. Davies Haines, president of Ciba Pharmaceutical Products, Inc.; Irving Wolff, vice president in charge of research, R.C.A. Laboratories; and J. J. Healy, assistant to the vice president for research, development, and engineering, Monsanto Chemical Company. The conference proceedings will be published by King's Crown Press, Columbia University.

■ More than 1000 chemical engineers gathered recently in New Orleans to attend the national meeting of the American Institute of Chemical Engineers. The program included five symposia and 28 technical papers. Great interest centered around a panel discussion on "Effective financial aid to the colleges from industry," which was led by Kenneth O. Beatty, Jr., of North Carolina State College.

C. W. Humphreys, manager of Shell Chemical Corporation, New York, presided over a symposium on "Foreign chemical developments and their effect on the U.S. chemical industry," and Walter G. Whitman, president of the institute, and secretary-general of last summer's International Conference on the Peaceful Uses of Atomic Energy, participated in a specially televised program that stressed the shortage of scientific and engineering graduates and dramatized the advantages of choosing a scientific career.

■ Fisk University is sponsoring its seventh annual Infrared Spectroscopy Institute 27–31 Aug. The Fisk institutes serve to introduce chemists, biologists, physicists, and engineers to infrared spectroscopy and its use in industry, in research, and in teaching. Participants will have opportunities during the week to discuss problems of their own particular interest with the institute faculty. Further information and application forms may be obtained by writing to Nelson Fuson, Infrared Spectroscopy Institute, Fisk University, Nashville, Tenn.

■ The second congress of the World Confederation for Physical Therapy will open in New York on 18 June. Jonas E. Salk will take part in a panel discussion on

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physical therapists' role in evaluation studies following field trials of the poliomyelitis vaccine. Other participants will be Thomas Francis, Jr., University of Michigan, who directed the evaluation of field tests; Lucy Blair, American Physical Therapy Association; and Miriam Jacobs, Watson School of Psychiatrics, Leetsdale, Pa. More than 2000 physical therapists and health specialists from the United States and some 20 other countries are expected to attend the 5-day congress.

Forthcoming Events

June

25–27. Symposium on Uses of High Temperatures in Science and Industry, Berkeley, Calif. (N.K. Hiester, Stanford Research Inst., Menlo Park, Calif.)

25–29. American Soc. for Engineering Education, annual, Ames, Iowa. (W. Leighton Collins, Univ. of Illinois, Urbana.)

25–29. American Inst. of Electrical Engineers, Summer and Pacific General, San Francisco, Calif. (N. S. Hibshman, AIEE, 33 W. 39 St., New York 18.)

25–29. Alpha Chi Sigma Fraternity, biennial convention, University Park, Pa. (J. R. Kuebler, 5503 E. Washington St., Indianapolis 19, Ind.)

25–29. International Cong. on Physio-Pathology of Animal Reproduction and of Artificial Insemination, 3d, Cambridge, England. (J. Edwards, Production Div., Milk Marketing Board, Thames Ditton, Surrey, England.)

25–29. Ship Behavior at Sea, seminar, Hoboken, N.J. (Experimental Towing Tank Laboratory, Stevens Inst. of Technology, 711 Hudson St., Hoboken.)

25–30. International Assoc. for Bridge and Structural Engineering, 5th cong., Lisbon, Portugal. (M. L. Gretner, Swiss Federal Inst. of Technology, Zurich, Switzerland.)

26–28. Entomological Soc. of America, Pacific Branch, Berkeley, Calif. (L. M. Smith, Dept. of Entomology, Univ. of California, Davis.)

26–29. American Home Economics Assoc., annual, Washington, D.C. (Miss M. Horton, AHEA, 1600 20 St., NW, Washington 9.)

28–1. International Scientific Conf. of Rheumatism, Aix-les-Bains, France. (M. Graber-Duvernay, 6, rue de Liege, Aix-les-Bains.)

11–15. Conf. on Industrial Research, 7th annual, Harriman, N.Y. (R. T. Livingston, 409 Engineering, Columbia Univ., New York 27.)

28–1. Symposium on Comparative Biology of Aquatic Species, Roscoff, Brittany, France. (G. Montalenti, Instituto di Genetica, Naples, Italy.)

July

1–7. International Conf. on Nuclear Reactions, Amsterdam, Netherlands. (S. A. Wouthuysen, Zeeman Laboratorium, Pl. Muidergracht 4, Amsterdam (C).)

1–7. National Education Assoc., Portland, Oreg. (W. G. Carr, NEA, 1201 16 St., NW, Washington, D.C.)

2. Astronomical League, Miami, Fla. (W. A. Cherup, 4 Klopfer St., Millvale, Pittsburgh 9, Pa.)

2. Gamma Sigma Delta Biennial Conclave, Ames, Iowa. (J. A. Johnson, Dept. of Flour and Feed Milling Industry, Kansas State College, Manhattan.)

2–3. National Science Teachers Assoc., Corvallis, Oreg. (R. H. Carleton, NSTA, 1201 16 St., NW, Washington 6.)

2–7. Brazilian Soc. for the Progress of Science, 8th annual, Ouro Preto, Minas Gerais. (Sociedade Brasileira para o Progresso da Ciencia, Caixa Postal 2926, São Paulo, Brazil.)

6–14. International Union of Forestry Research Organizations, 12th cong., Oxford, England. (Secretariat of Union, Viale delle Terme di Caracalla, Rome, Italy.)

9–11. Symposium on Chemical Additives in Foods, 2nd of 5 symposiums, Amsterdam, Netherlands. (H. F. DuPont, International Bureau of Analytical Chemistry, 18 Ave. de Villars, Paris 7, France.)

11–14. American Malacological Union, annual, San Diego, Calif. (Mrs. M. C. Teskey, P.O. Box 238, Marinette, Wis.)

12–14. International Astrophysical Symposium on Molecules in Cosmic Sources, 7th, Liege, Belgium. (H. C. Urey, Inst. for Nuclear Studies, Univ. of Chicago, Chicago 37, Ill.)

16–17. Symposium on Synthetic Polymer Chemistry, Notre Dame, Ind. (G. F. D'Alelio, Dept. of Chemistry, Univ. of Notre Dame, Notre Dame.)

16–21. French Assoc. for the Advancement of Science, Dijon, France. (Mlle. Henri-Martin, Secretary, 28, rue Serpente, Paris 6e.)

17–26. International Soc. of Photogrammetry, 8th cong., Stockholm, Sweden. (P. O. Fagerholm, Bragevägen 8, Stockholm.)

18–20. Soc. for the Study of Development and Growth, annual, Providence, R.I. (M. V. Edds, Jr., Brown Univ., Providence 12.)

(See issue of 18 May for comprehensive list)

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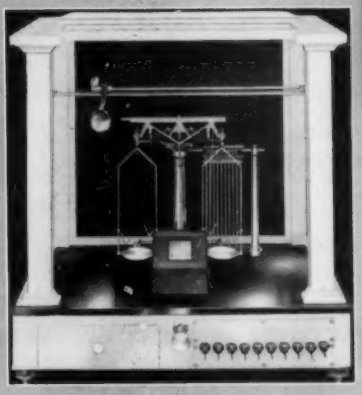

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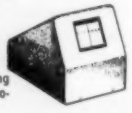

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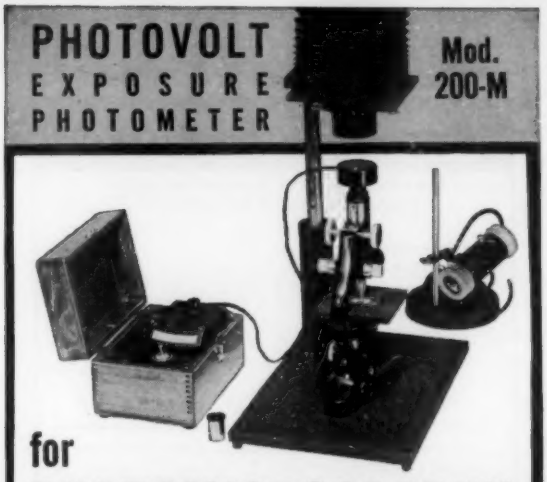

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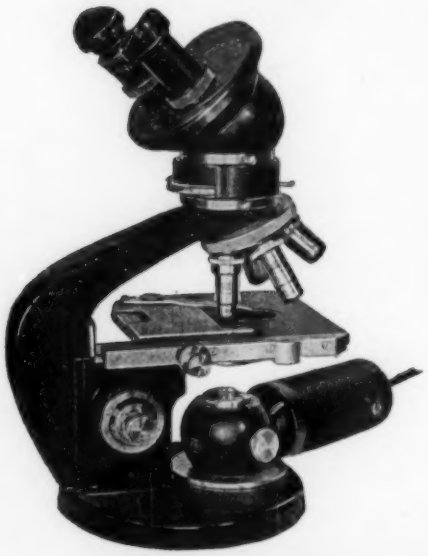

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